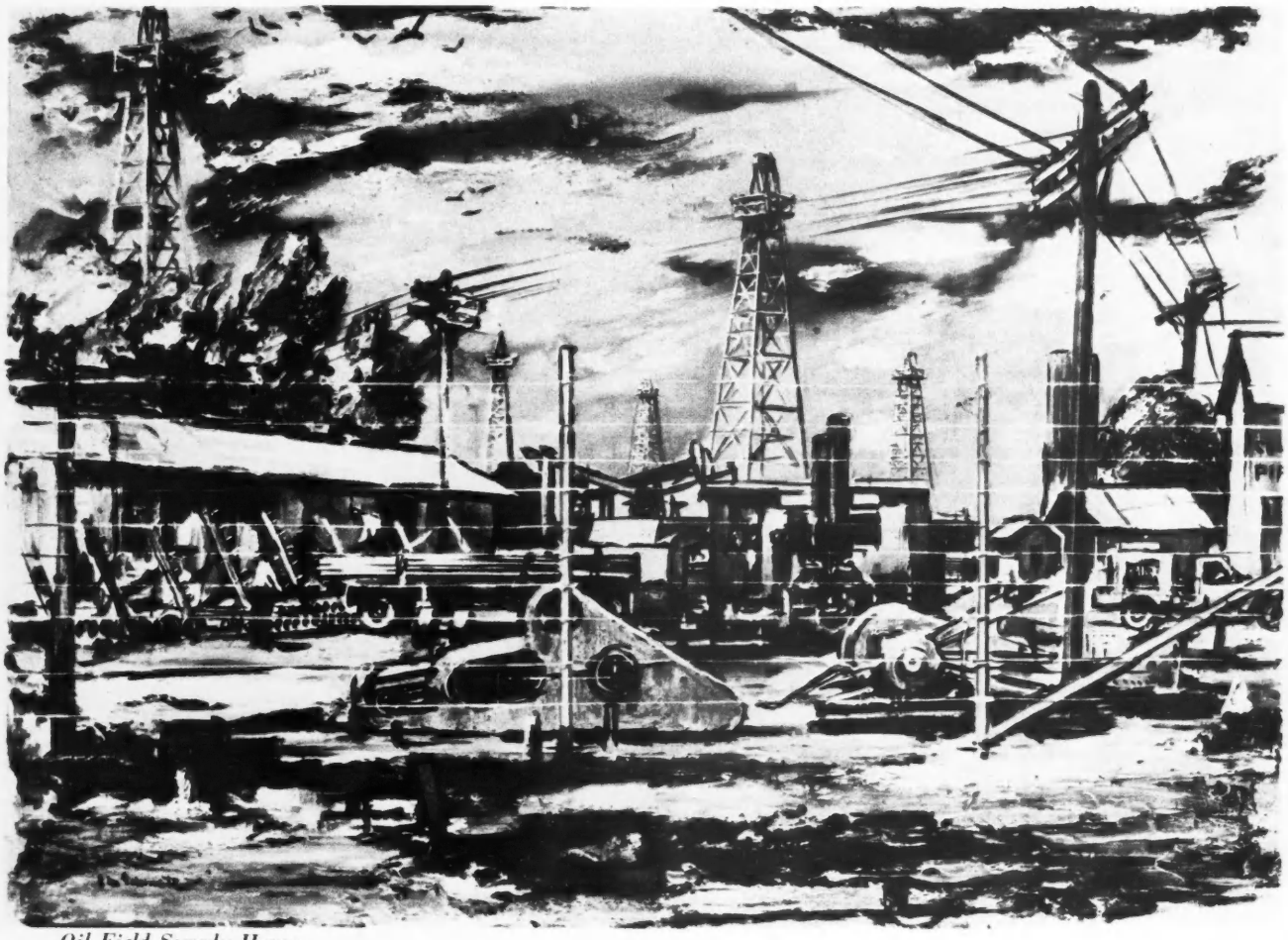


Oil Field Supply House

The HUMBLE WAY

SEPTEMBER-OCTOBER, 1946

The HUMBLE WAY

Vol. II SEPTEMBER-OCTOBER 1946 No. 3

A TOOL FOR EVERY JOB

WHEN Colonel Edwin L. Drake answered the call of his driller, William A. Smith, on Sunday morning, August 28, 1859, and hurried out to the well in Oil Creek Valley to find it full of oil, he earned the distinction of being the father of not only one great industry but of two. The oil industry itself had its humble beginning there, yes. But at the very same time there was born also on that day the oil field equipment manufacturing industry—one which is closely interwoven with the oil industry and is scattered over the wide world, one whose investment runs into hundreds of millions of dollars.

To be sure, Colonel Drake began drilling operations on the now historic well with much the same type of equipment as had been in use for many years for drilling salt wells, but history also records that he had some items of equipment specially built. His driller, "Uncle Billy" Smith, who had been a Tarentum, Pennsylvania, blacksmith up to the time Colonel Drake hired him for the job, was commissioned to make the boring tools. The Colonel supplied the iron and the blacksmith-driller fashioned a full set of boring tools, two spear boxes, four spear pins, and 16 sucker joints for a sum total of $76.50.*

The derrick made of pine poles cut near the well site; the "Long John" steam engine used for power; and the rest of the derrick assembly—all these were similar in every respect to the derricks and equipment assemblies used by salt well drillers. Even the boring tools which "Uncle Billy" Smith made very probably could have been obtained from the same sources which salt well drillers had been drawing on, but the fact remains that Colonel Drake had them made for use on his well.

The excitement which the Drake well caused spread far and wide, so that within four years of the discovery date oil had been found in Kansas, Colorado, California, Ohio, and West Virginia. Because the immediate widespread demand for oil kept the price high, all of these early wells were "kicked down" quickly to shallow pay sand and the oil was brought to the surface either by power pump, or by hand pump if the price of the former was not readily available.

Pumping equipment, the oil industry's first, was borrowed directly from the salt brine business. Wooden sucker rods actuating a traveling valve in a working barrel brought the oil up through brass tubing; once at the surface, the oil was handled through wooden troughs into barrels for transportation.

Oil came comparatively easy in those first years, but imaginative, farsighted men, then as today, sought better ways and means to produce it. For instance, it was only two years after the first discovery that A. P. Funk reasoned that flowing oil wells might be possible if one drilled deeper to encounter greater pressure. History records that in 1861 he drilled down to the "third" sand at Oil Creek, to a depth

* Oil & Gas Journal, August 27, 1934.

WORKMEN CLIMB ABOUT in the web-like pattern of a 30,000-barrel storage tank under construction at the Waco terminal on the recently opened Baytown-to-North Texas products pipe line.

of 400 feet, and then drilled in another 50 feet to bring in a flowing well which promptly became known as the "Fountain" well. Others followed in quick succession, and immediately this greater production dictated the need for storage tanks at the well sites. That brought about the construction of wooden tanks made of tapered staves and flat hoops, similar to those which still may be seen at Goose Creek and other old fields in Texas. The need to shut in these wells when the wooden tanks were full also brought about the perfection of the first type of well head control equipment. Tubing on those early flowing wells was brought up out of the well high enough to permit the flow of oil directly into the storage tanks. By the installation of a valve or gate on this tubing the flow could be controlled. Simple indeed, but that was the forerunner of today's scientifically designed and sturdily built "christmas tree."

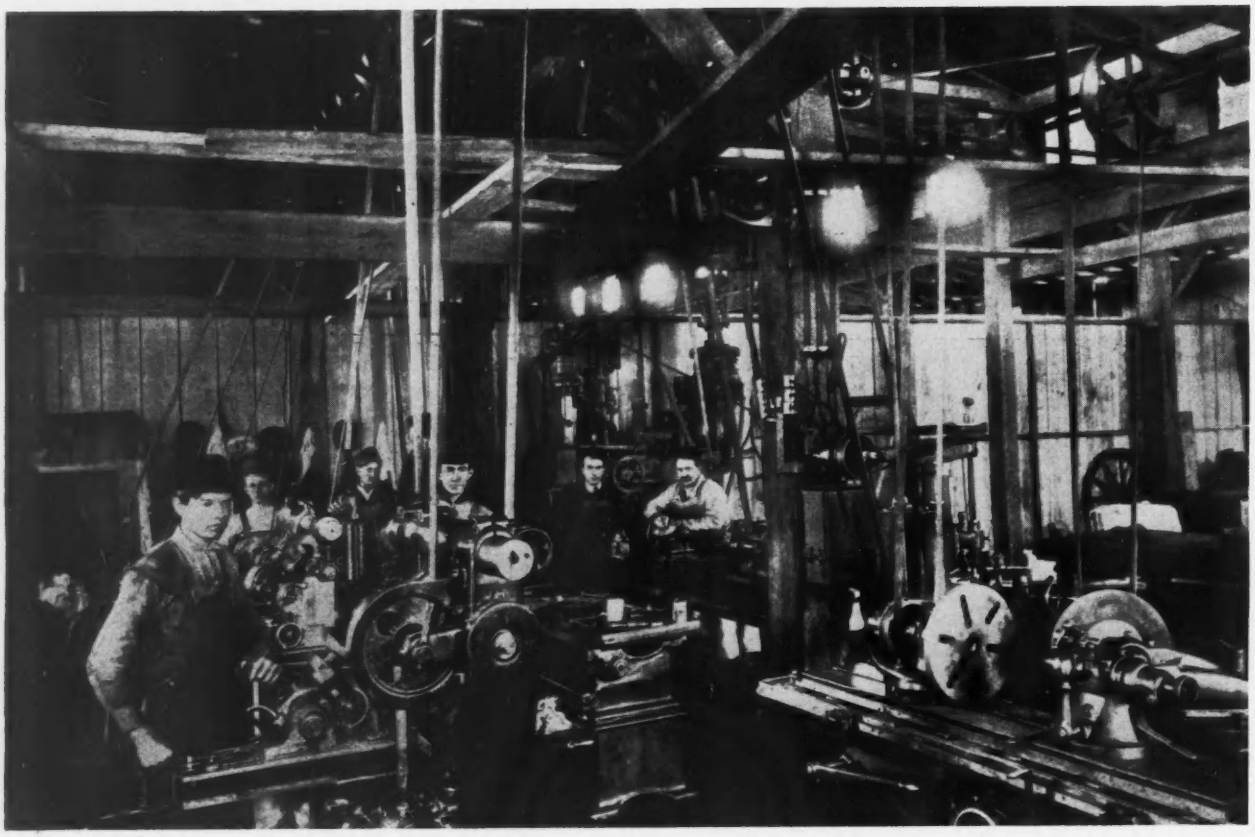
Because most of the oil discoveries of real significance during the latter part of the 19th century were made in Pennsylvania and in nearby Ohio and West Virginia, it was only natural that the industry supplying the necessary tools for oil exploration should be concentrated in that area. Too. Pittsburgh was even then the steel center of America, and that made it simple for the equipment manufacturers to spring up and expand near their source of raw material and near their market. During the early oil years it was not uncommon to find existing manufacturers of engines and pumps and other steel products supplying the oil industry; however, near the end of the century there was born a considerable number of manufacturing plants which specialized in oil field equipment. Under the guidance of far-sighted, aggressive leaders these plants flourished, and today a number of those early names are bywords in the equipment and the oil industries.

Under the impact of growing demand and growing competition, significant advancements were made in power machinery and drilling equipment during the 80's and 90's, but most of these came in the form of refinements on existing equipment and in the development of heavier equipment for deeper drilling. Boring tools, for instance, were increased in weight from 100 or 200 pounds to 2,000 or 3,000 pounds. Wooden derricks and other pieces of wooden equipment were strengthened with iron—a trend that was dictated both by a growing scarcity of good timbers and by the greater need for strength with less weight to handle the loads of deeper drilling. The growing demand for equipment during this era brought on some standardization and with it a reduction in cost. Old records covering the period up to 1900 show that the equipment needed for a 1,000-foot well (less derrick and power plant) cost about $325.00 less in 1890 than in 1878.

Through trial and error and through the accumulation of field experience under all kinds of conditions, manufacturers began perfecting new and revolutionary units of equipment. Probably the most significant were the rotary drilling outfit and the steel derrick—both of which made their appearance around 1900.

The rotary drilling system had its origin in South Dakota, where it was first employed about 1882 by M. C. and C. E.

INTERIOR VIEW, BACK IN 1909, IN ONE OF THE SOUTHWEST'S PIONEER OIL FIELD EQUIPMENT MANUFACTURING CONCERNS



Baker in the drilling of water wells. When they brought it to Texas in 1896, they found a very interested audience in three experienced Texas drillers who had played a significant part in the opening of the state's first important oil field at Corsicana. The Texans saw the possibilities of using the method for drilling oil wells in comparatively soft Texas formations and took a hand in its further development. Few pieces of revolutionary equipment have been introduced so dramatically as the rotary unit. The very first one used on an oil well was used on the fabulous Lucas Gusher which brought in Spindletop and skyrocketed Texas into the oil limelight.

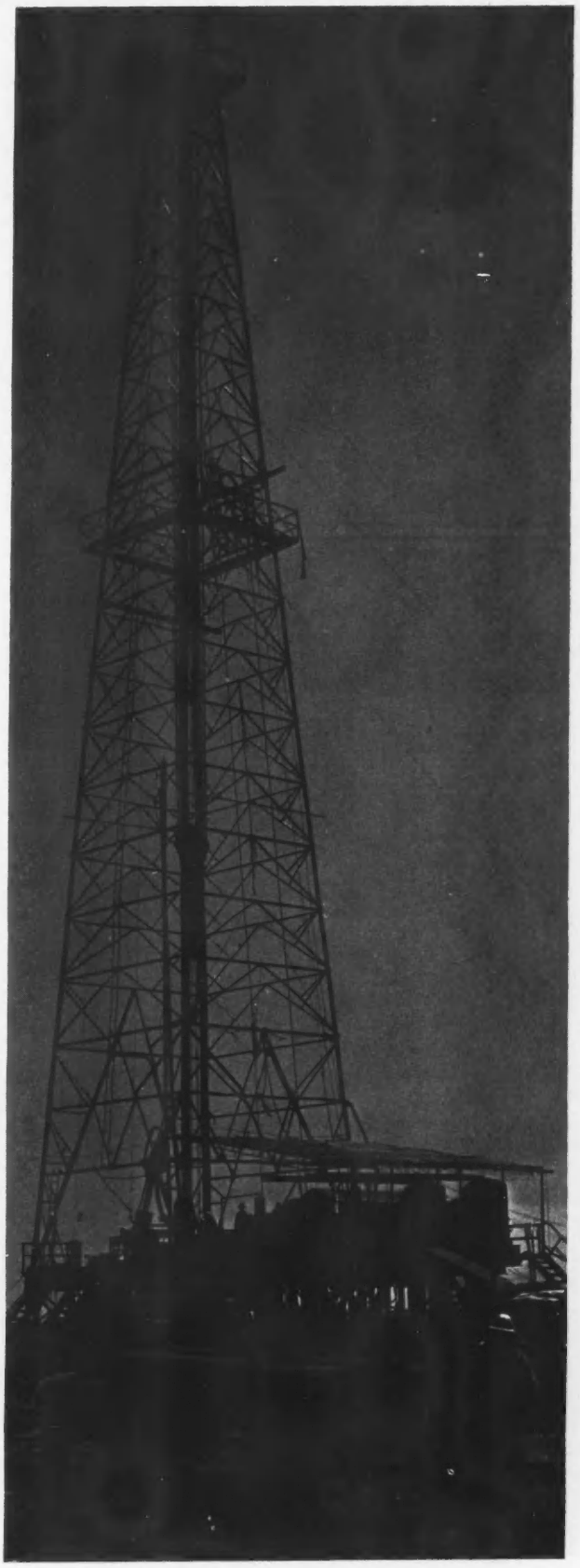
In spite of this convincing introduction, however, rotary drilling equipment did not take hold as rapidly as might have been expected. And there were good reasons. Rotary tools were introduced at Spindletop in the hope that they would help combat the frequent cave-ins of the non-cohesive shales and sands, caused by vibration. This they accomplished. Rotary tools also were designed for deeper drilling. During the period between Spindletop and the end of World War I, oil operators ranged far and wide across the face of the earth and aided by the comparatively new science of geology they found much shallow or "easy" oil. Although record books show that an oil well was drilled to a depth of 5,575 feet in Pennsylvania as early as 1898, it was not until 1919 that the deepest producing field in this country was down to 5,400 feet. Still more indicative of the slow acceptance or need for rotary tools is the report by U. S. Bureau of Mines in Bulletin 201, published in 1922.* Here we read that "approximately 100,000 of the 109,000 wells estimated as completed during the 1914-1918 period were drilled with cable tools . . . Cable tools are especially adapted to prospecting."

The steel derrick, too, was slow to be accepted. It was not until geologists pointed the way to deeper oil producing horizons that the trend swung sharply to their use. When the industry made the change around 1917 to 1920 the demand suddenly became so great that existing derrick building concerns and a number of new ones which promptly entered the field could not supply the needs. That condition did not prevail for long, and today the steel derrick is such an essential part of oil field equipment that a wooden derrick is truly a rarity in American oil fields undergoing developments.

Another signal event which affected both the oil industry and the equipment and supply manufacturing industry was the establishment of the U. S. Bureau of Mines in 1910. Engineers of this government agency set about to study the oil business and some of its most vexing problems, and during the first decade after its founding the Bureau made so many worthwhile contributions toward better operations in the oil industry as to firmly establish the practice of applying engineering principles to the oil drilling and producing business.

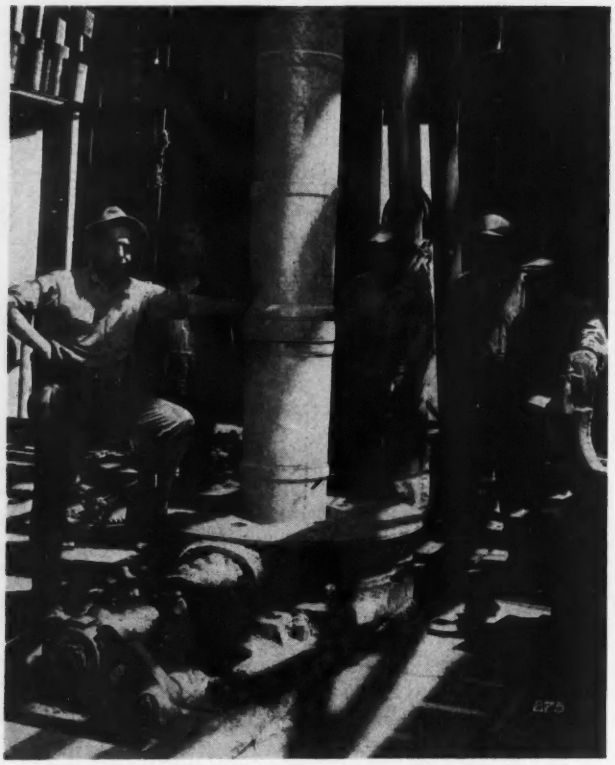
The oil industry was quick to accept this fact. There appears to be no accurate record as to who was the first practical petroleum engineer, or by whom he was employed, but all writing about the industry points to the fact that these pioneers entered the picture shortly before 1920. Not

* R. E. Collum, "Prospecting and Testing for Oil and Gas."



FAST AND EFFICIENT delivery of pipe and other needed materials from strategically located supply stores has been a boon to the widespread search for oil in isolated regions of the United States.

WELL HEAD CONTROL equipment in the early days was very simple; later it became highly complicated; today, as shown above, it is quite simple again in spite of extreme pressures in deep wells.



A FAR CRY FROM today's scientifically designed equipment is this early type of rotary table with exposed gears. The stovepipe casing and the garb of the crew point to an era about three decades ago.

that they walked in and announced themselves as petroleum engineers; they began modestly as mechanical engineers to assist production superintendents with the installation of mechanical equipment. It was not many years, however, before these engineers—observant, capable, practical men—began to fill a vital place in the business of drilling for and producing oil. Successful use of their talents by one operator or company soon brought others to the same way of thinking, and eventually the entire industry.

Here, then, was a three-way pattern of cooperative effort. Engineers and research technicians of equipment manufacturing firms cooperated with petroleum engineers and Bureau of Mines specialists to solve drilling and producing problems, either with improved equipment or new and revolutionary units. Perfection of instruments for determining deflection of the drilling bit to avoid crooked holes was brought about in the 20's; control of wild wells by directional drilling was also undertaken; and improvements in the technique of cementing casing. New and better types of drilling bits including application of hard metal joints to increase footage drilled; blow-out preventers to permit control of wells if they should come in suddenly; weight indicator to show the weight or load carried on the bit; greater knowledge of mud and proper mud weights; perfection of better well shooting and acidization equipment and methods were among the advancements during this period. The trend toward deeper wells and accompanying greater pressures, also the drilling of wells in abnormal pressure fields, demanded careful study and expert design of casing programs and of well head fittings; "christmas trees" soon became complicated units, with valves and fittings arranged in almost every conceivable manner. However, the "christmas tree" of today has been greatly simplified, and uses only a few valves. Equipment manufacturers sought to build well head equipment to meet varying conditions in different fields. The efficient use of casing by the careful application of the proper combination of weight and grade also saved the industry many thousands of dollars. High pressure oil and gas separators to handle the production from high pressure fields were perfected; beam pumping, although an old method, made great strides through the improvement and development of unitized pumping and power equipment; and special metals were used to reduce to a minimum the problem of wear and corrosion of well equipment. Invention of sub-surface pressure instruments; the development of electric well logging and coring; the introduction of new methods and new tools for cleaning out wells; and the use of chemicals for treating oil—all of these were progressive strides made by the cooperative effort of equipment manufacturer's laboratories and their designing and field engineers, mechanical and petroleum engineers, and engineers in the service of the U. S. Bureau of Mines.

In many cases alert manufacturers devised special units or special services for the oil industry in anticipation of potentially acute problems; in other instances, oil industry engineering departments and experienced field operators have taken ideas for improved equipment to manufacturers with the suggestion that an attempt be made to make a special unit to solve a problem that threatened to become acute.

Alert at all times for new markets, the equipment industry has spent millions of dollars in research and testing. Fine laboratories have been built during the past decade, enabling manufacturers to design and test equipment for the purpose

of meeting tomorrow's problems. Manufacturers' field engineers and petroleum engineers, keeping a watchful eye on performance under all kinds of conditions, have made possible the improvement of many pieces of equipment for all-purpose use, or the redesign thereof for special service.

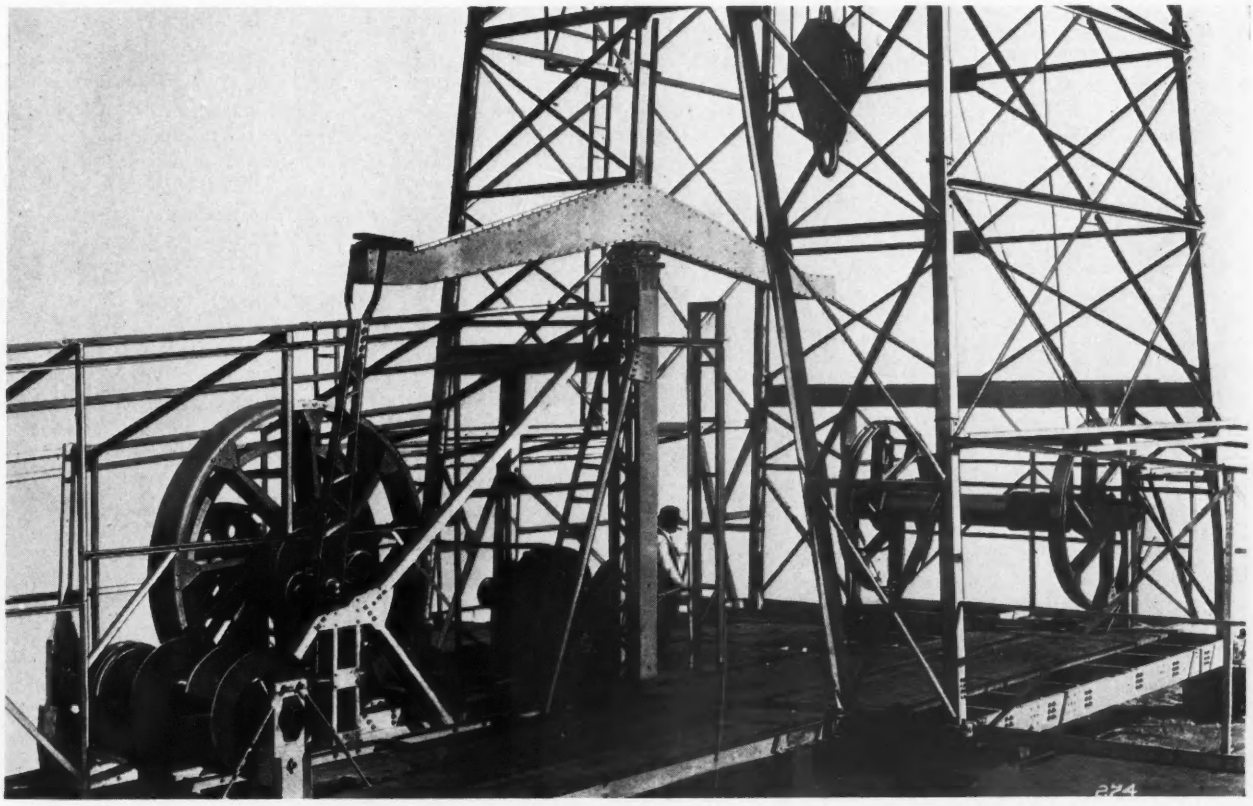
Among the outstanding developments in equipment during the past ten or fifteen years we find: All steel derrick substructure and engine substructures; 136-ft. and taller steel derricks with large bases; unitized fully enclosed oilbath drawworks; geared type drawworks with air-operated clutches and brakes; controls for rate of feed of drilling bit; fully enclosed oilbath rotary machines; independently driven rotary machine; air-operated rotary slips; power operated tubing tongs; all-welded domeless type boiler; unitized feed water heater and pump assembly; welded-in blade drag bit; well surveying instruments; side-wall coring outfit; unitized pumping machine; portable derricks and collapsible masts; truck mounted well-servicing winches; and hydraulically operated subsurface pumps.

In addition to manufacturing the tools needed by the oil industry, the equipment industry has demonstrated its eagerness to serve and to be cooperative by giving remarkable service. It has spread its manufacturing and sub-manufacturing plants across the nation so strategically as to enable it to serve the oil drilling and producing industry speedily. Although original headquarters for an important oil tool concern was at Pittsburgh or Oil City, Pennsylvania, it is quite probable that the firm today has branch plants in Houston, Tulsa, Chicago, and San Francisco. By the same token, manufacturers who came into the field later and established their first plants in the Mid-Continent or on the Gulf Coast have spread their branch plants into other areas where oil development has occurred.

So great has the oil tool and equipment industry grown that today there are approximately 1,000 manufacturing concerns engaged wholly or in part in the business of supplying equipment for the oil drilling or producing industry. While a certain number of these make only specialty products, such as bearings, belting, wire rope, and other products for the oil industry and other heavy industries, a high percentage of them are engaged in making tools and equipment only for the oil business. In addition to these manufacturing plants and to the branch offices and warehouses of these manufacturers, there are more than 1,000 field supply stores carrying stocks of all kinds of tools and equipment to serve the oil industry. So widely and so well have these field stores been scattered about the oil producing areas of the United States that even the most isolated wildcat well is not far from a supply store where needed materials may be secured quickly. In fact, this fast, expert service has been a boon to the greater and more widespread search for oil in this country than in any country on the face of the earth. In the early days wildcatters were reluctant to drill too far from established areas because of the difficulty of obtaining and transporting to location the needed materials; today, the supply industry has set up such a fast and efficient delivery system and such a strategically spaced supply store chain that no wildcatter need be deterred from drilling anywhere for that reason.

Also to the credit of America's oil field equipment industry is the readiness with which it has followed American geologists, geophysicists, and drilling contractors into the isolated

ALL-STEEL CABLE TOOL RIG AND DERRICK CAME INTO POPULAR USE WITH DEEPER DRILLING AFTER WORLD WAR I



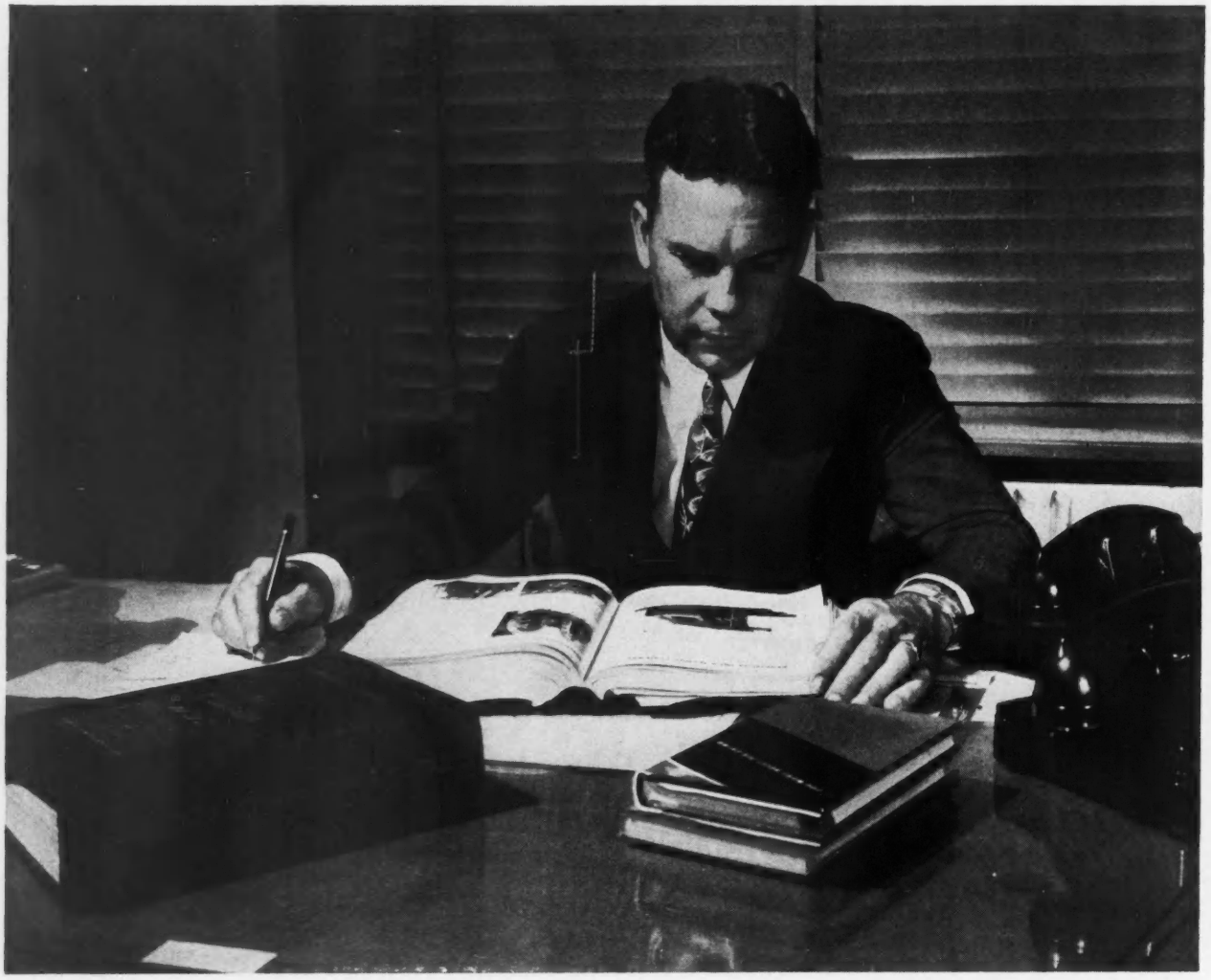
spots of the world in the search for oil. American petroleum engineering and American tools and equipment have occupied for many years such a position of leadership that they are virtually standard the world over. That is borne out rather dramatically by the fact that student petroleum engineers from foreign lands begin their academic work by learning the English language, because almost all of the oil industry's technical literature is in English and the best available training courses are offered in American colleges and universities.

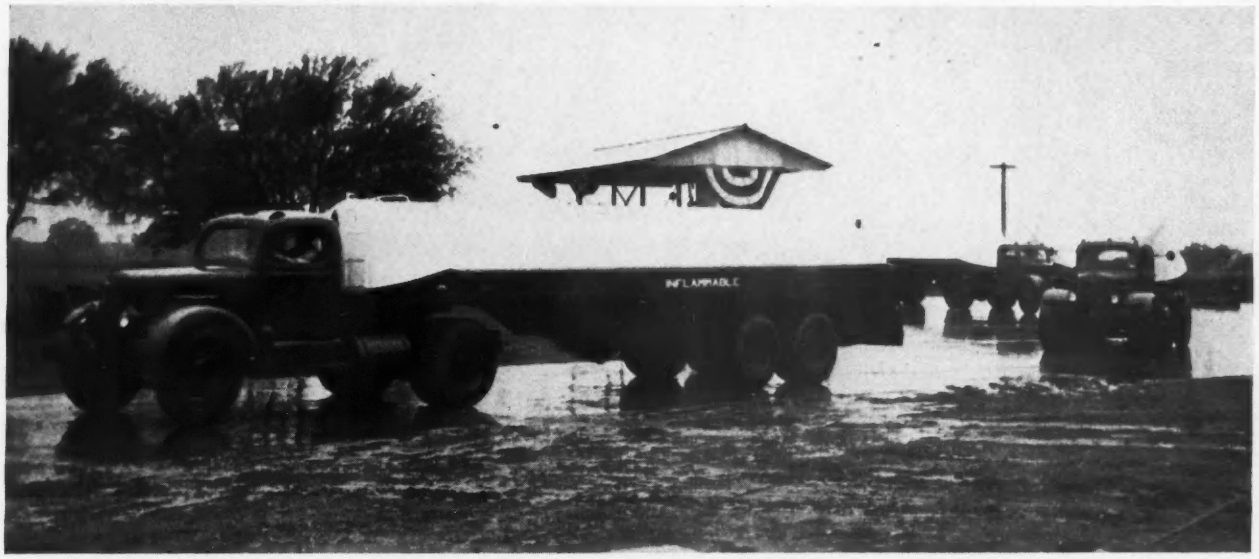
A final tribute to the oil field equipment industry is its contribution during the recent war years. By and large the industry was engaged in the manufacture of war materials. Few were the plants which did not turn from peacetime pursuits to aid in America's vast and diversified schedule of producing heavy war equipment. In spite of this transition, which in fact was made by all heavy industry, the oil tool equipment manufacturers continued to make and supply the minimum necessary requirements for the oil industry. Oil was so vital to war making that although drilling operations were curtailed some for lack of manpower and materials, the producing end was stepped up to a tempo never before experienced in this country. Here, then, the equipment industry had to supply the new and improved units needed to keep oil flowing in vast quantities. This it did. And though it had not the time to continue research at the pace to which it was accustomed before the war, the industry today is in good position to develop, manufacture, and deliver the advanced tools and machinery the oil industry needs to find oil for the future and to produce today's needs economically.

The sound, solid foundation on which the equipment industry has been built over the period of America's greatest expansion in oil; the spirit of cooperation which the industry has fostered between itself and drilling and production engineers through the years; and the desire to serve the oil industry and to progress with it—these auger well for the future of the oil field equipment manufacturing and supply industry.

No matter how difficult may seem the job of finding tomorrow's oil; no matter how much more complex and more precise tomorrow's tools and equipment will have to be; the equipment industry through research and sound study of oil problems stands prepared to insure the oil drilling and producing business that there will be *a tool for every job.*

OIL COMPANY PURCHASING AGENTS CONSULT HUGE CATALOGS TO FIND THE MAKERS OF TOOLS AND EQUIPMENT NEEDED





BIG TANK TRUCKS, EACH WITH A CAPACITY OF ABOUT 4,500 GALLONS, LEFT THE TERMINAL DURING THE CEREMONY.

Products Line Terminal Opened

An audience of approximately 250, made up of citizens of Irving, newspaper editors, employees of the Humble Companies, and Humble friends in North Texas, gathered at the Irving Terminal of the recently completed products pipe line on October 15 for formal opening ceremonies.

Mayor Jack Johnson of Irving greeted the guests and welcomed the Humble Companies to his community. President R. V. Hanrahan said that although the line's capacity is 15,000 barrels a day, the Pipe Line organization promises to deliver gasoline in whatever quantity is needed to fill demand. Director J. A. Neath, Humble Oil & Refining Company, pronounced the completion of the line and terminal an accomplishment of cooperation between Sales department and Pipe Line Company employees. Sales Manager F. A. Watts outlined the opportunities for expanded sales operations resulting from the completion of the line. Executive Vice-President Hines H. Baker explained that a vast background of research and technology in production, transportation and refining is behind the quality products which the pipe line will enable the Humble Company to distribute in the North Texas are. At program's end a barbecue dinner was served.

ENJOYING FELLOWSHIP, left to right: J. A. Neath, director, and Hines H. Baker, executive vice president of Humble Oil & Refining Company; R. V. Hanrahan, president of Humble Pipe Line Company; Jack Johnson, Mayor of Irving; and Frank Oldham, terminal manager.

ENJOYING BARBECUE, left to right, F. D. McMahon, assistant general superintendent of Humble Pipe Line Company; O. R. Smith, contractor; A. E. Payne, Southern division superintendent; H. M. Lingle, purchasing agent; and A. E. Pecore, chief engineer.

Pilot Plants
Pave the Way

BEHIND every phase of Humble's refining operations are the technical and research men, those members of the thought-and-slide-rule fraternity whose job it is to increase and improve production at the units to which they are assigned.

Theirs is the long range viewpoint, the ultimate responsibility for bridging the gap between today and tomorrow. Regarding each unit and its processes through critical eyes, they are alert for clues which might lead to better products and more efficient operations. While others are busy with problems of the moment, research men are engaged in projects proposed to solve the problems of the future.

Pilot plants, miniature concentrations of refining equipment bearing little resemblance to huge field plants but designed to do similar jobs, are the last stage of research before plant-scale operations are begun. They are appropriately named, for experiments conducted at pilot plants literally lead the way to more efficient, more economical commercial production.

Research projects are designed to serve one or more basic purposes. They may be used to demonstrate manufacture of new products; or, through experiments related to mechanical and chemical engineering, they may be employed to increase the efficiency of present processes.

There are pilot plants at Baytown for almost every type of refining process, including fluid catalyst cracking, hydrogenation, fractionation, and Butyl polymerization. Usually, pilot plants are built in advance of the field units, so as to indicate the most economical type of commercial production. Afterward, they serve as control units to define the most efficient manner of operation.

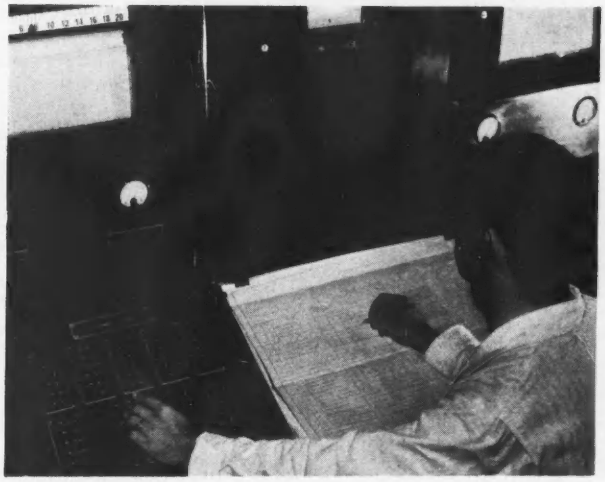
Sometimes, however, a pilot plant is not built until the commercial unit is placed in operation. This is true of the newest and most elaborate among Humble's facilities for research in refining, the Pilot Fluid Catalyst Cracking Unit, abbreviated on Baytown's books to PFCCU. Popularly, it is called the "kitty cracker," in contrast to the two full-sized "cat crackers." Completed in August, 1945, it belongs to a small but distinguished family; there are less than a dozen similar units in the world.

The PFCCU is being used to study various feed stocks for catalytic cracking and to observe results obtained from different ways of using those feed stocks. It is a case, if you will, of the kitten deciding what to feed the cats.

One of the first experiments in catalytic cracking conducted at Baytown was to employ charge stock and catalyst that had been sampled from the No. 2 Fluid Catalyst Cracking Unit during a test run from which good data had been obtained. By running the same materials in the pilot plant at the same temperature and at conditions to give the same production of useful products, a valuable comparison of the operation of the pilot and commercial plants was obtained.

Next, a typical PGO stock (*process gas oil*, heavy product of distillation) was taken and run under a number of operat-

CONFERENCES AMONG technical personnel are conducted to plan operations as well as to exchange ideas and information on pilot plant progress. These men are working on fluid catalyst cracking research.



TEMPERATURE FOR the pilot plant is recorded at a central switchboard. With switches, operator takes temperature at points around the unit. Electric resistance wires maintain heat in lines and vessels. Leaks (below) cannot be tolerated when loss of as much as a cupful per day will upset data on experiments. Note welding detail on pipe fittings.

PROTECTED AGAINST BURNS, operator at Pilot Fluid Catalyst Cracking Unit draws off sample of hot catalyst to be tested for carbon.

ing conditions to cover a range of gasoline production. This was to develop a relationship between operating conditions and conversion to gasoline, as well as between conversion and product distribution for Humble's pilot plant.

Product distribution is a most important matter to those who seek to improve refining processes. For example, any means by which catalytic cracking at Baytown could be made to increase gasoline yield by as much as one per cent would be of considerable importance to the refinery.

The stage was now set for experiments conducted with charge stocks akin to process gas oil, which is the principal feed to the big cats. Experimental stocks included extract from kerosene manufacturing operations, extract from lubricating oil production, and clarified oil—a low-value by-product of catalytic cracking, itself. Even petrolatum from lubricating oil dewaxing—wax so thick and heavy it must be heated before it can be moved—was added to other materials and used as experimental feed stock.

Briefly, these tests showed that catalytic cracking can be conducted more profitably by shifting some feed stocks out of catalytic cracking and into other processes, as well as by adding materials which up to this time, had been used in other processes.

The validity of test run data from the PFCCU depends on accurate control of processing conditions and precise measurement of feed stocks charged, catalyst circulated, and products obtained. Automatic instruments control as much of the operation as possible, just as they do at the two field units. All charge stocks and products are weighed and measured with extreme care. For every 100 pounds of charge stock used, at least 98 or 99 pounds of products must be accounted for, or the test is considered unsatisfactory.

The importance of close measurements is such that even water produced in the cracking operation must be condensed, drawn off, and weighed. Steam employed in the process must be measured, too. It is impossible to measure such small quantities of steam by the conventional orifice meter method, so process steam is measured by weighing the water from which it is generated.

The PFCCU has shown adaptability to structural changes necessary for certain test runs. Studies made with its reactor (the vessel where oil and catalyst meet) may possibly lead to revision of reactors in the big field units.

Meanwhile, progress made with feed stock studies continues to justify the large investment in catalytic cracking research facilities. Discoveries with feed stocks alone give ample evidence that the pilot plant is paving the way to more efficient, more economical operations on a commercial scale.

CATALYST AND PRODUCTS ARE CAREFULLY LABELED, ENTERED IN LOG BOOK, THEN SENT UP FOR LABORATORY ANALYSES

Lectures in Science

NOW in progress at Baytown refinery are the first scientific lectures of an annual series inaugurated by the Company in August for the purpose of keeping Humble refinery technical and research specialists in touch with the latest developments in science and engineering.

The series is known as "Humble Lectures in Science." Its major purpose is to enable technical men to further certain aspects of their scientific training while gaining industrial experience, and to keep abreast of new developments in scientific fields closely related to their own. In short, the Company has devised a means of bringing university facilities to members of its scientific corps whose pre-occupation with duty prohibits long periods of graduate study.

Outstanding scientists will be invited each year to present topics in their fields of special study and research. The program for 1946-47 was opened by Dr. C. C. Price of the University of Notre Dame, who in August completed a series of lectures on "High Polymers." Following him is Dr. E. R. Gilliland of the Massachusetts Institute of Technology, whose lecture topic is "Transference of Processes from Small to Large Scale." The remainder of the first year's program includes series of lectures by Dr. R. C. Fuson of the University of Illinois on "Special Topics in Hydrocarbon Chemistry," and Dr. K. S. Pitzer of the University of California on "Spectra as Related to Structure and Thermodynamic Properties of Molecules."

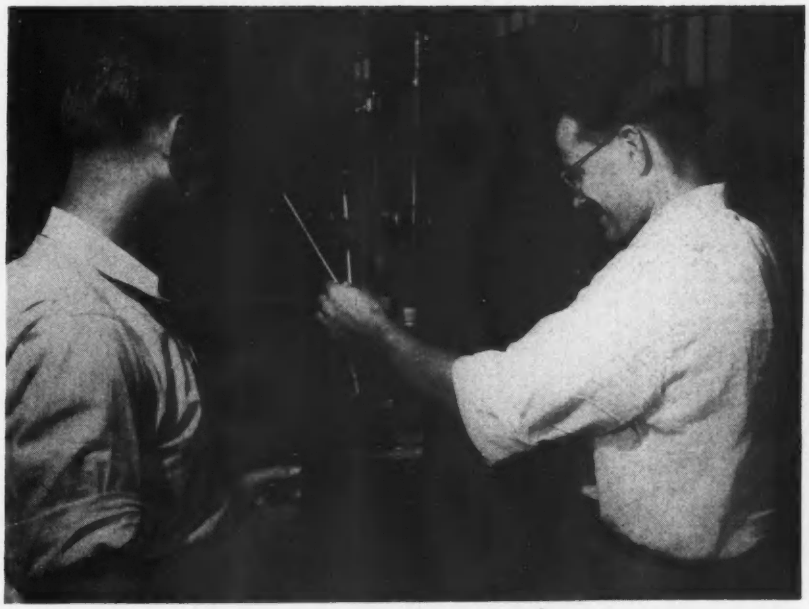
Each series of lectures is given for a period of one to two weeks, and Humble employees selected to attend devote full time to the instruction program.

Opportunities are also being provided for study of advanced topics in the sciences for those of the Company's refinery technical staff who have not had the benefit of formal graduate training. Included in this series are graduate level courses in physical chemistry, organic chemistry, and chemical engineering. Courses of this kind are, in general, to be given by scientists from nearby colleges and universities, such as Rice Institute and the University of Texas. Dr. F. A. Matsen of the University of Texas opened this series, lecturing on Physical Chemistry. He was joined late in September by Dr. H. L. Lochte, also of the University of Texas, who is lecturing on Organic Chemistry.

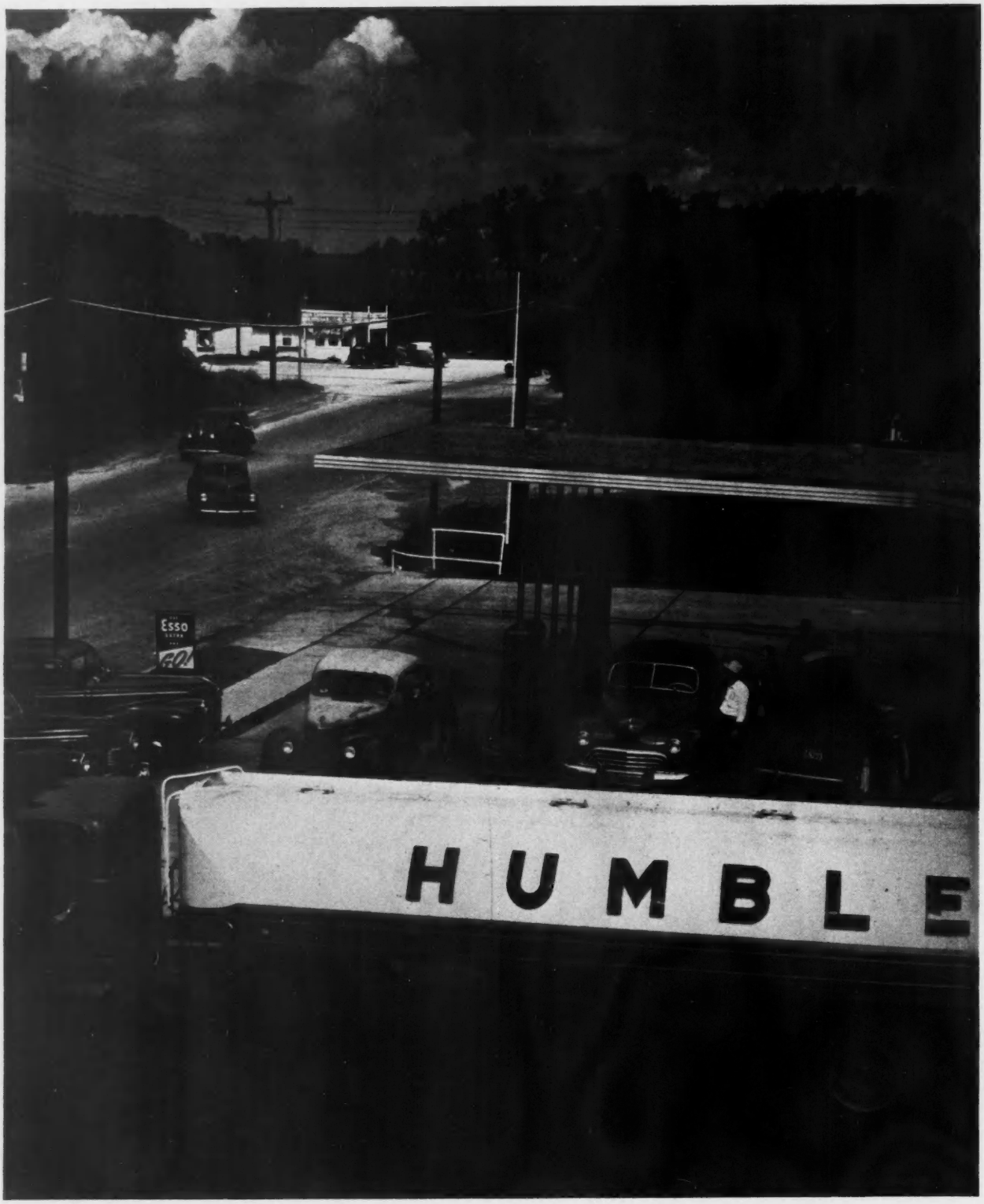
The number of technical and research people attending the lectures is limited, and selection is made upon the basis of the individual's need for the material being presented. Attendance is part of the regular duties of those selected for the courses, and they are excused from other assignments during lecture periods.

DR. H. L. LOCHTE, University of Texas, is lecturing on organic chemistry.

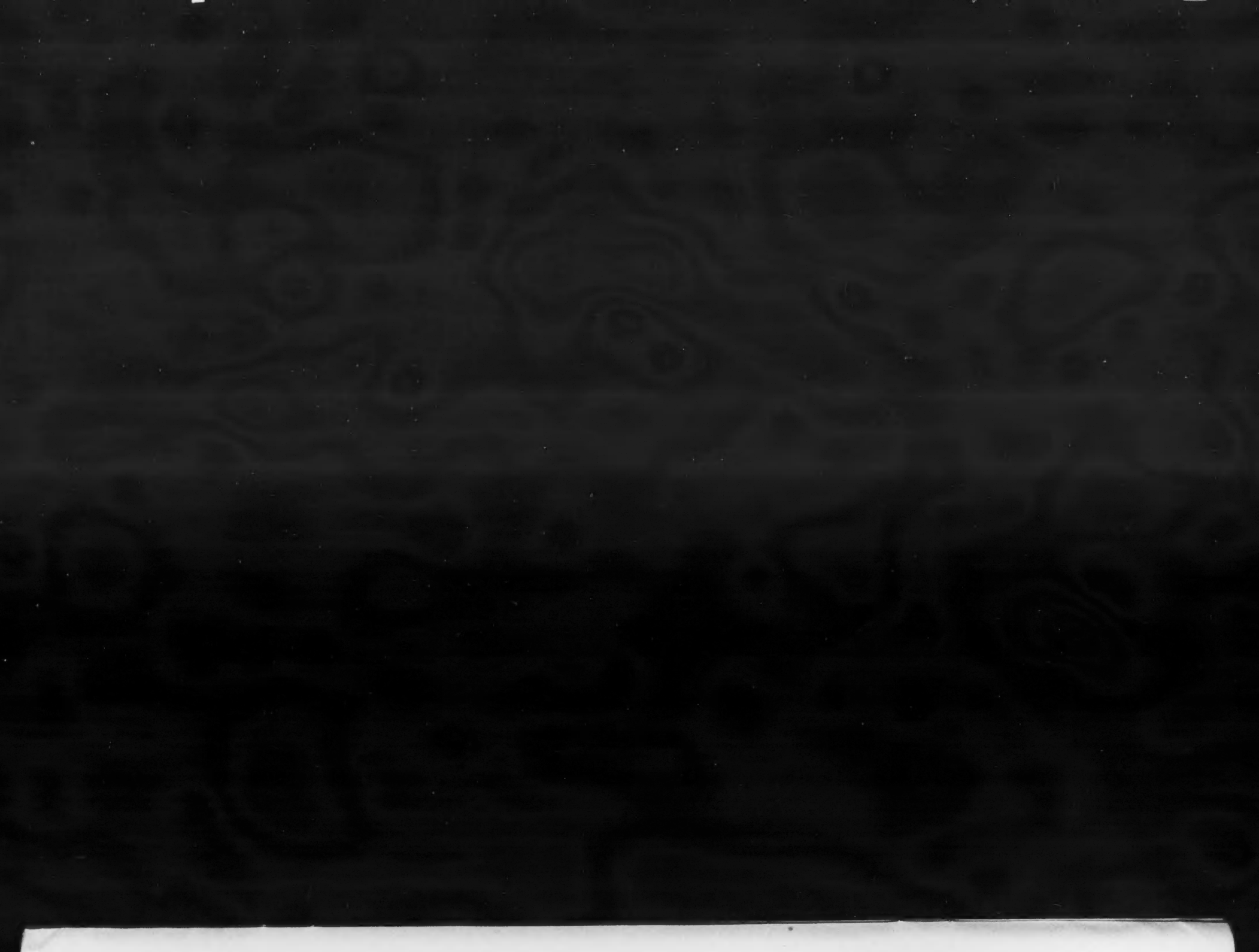
DR. F. A. MATSEN, University of Texas, is lecturing on physical chemistry.



DR. C. C. PRICE, of the University of Notre Dame, conducts a laboratory demonstration on the polymerization of methyl methacrylate. Dr. Price lectured on "High Polymer Chemistry" at Baytown refinery during the week ending August 24. Technical and research people attended.



BUSY DRIVEWAYS all over Texas give ample evidence of the popular acceptance of quality Humble products. Behind each gallon of high octane gasoline and each quart of fine motor oil delivered to drivers of automobiles there lies an enormous investment in property and plant facilities and a vast amount of research and technology in exploration, production, transportation, refining, and marketing. Today's quality results largely from wartime advancements. Supported by this background, carefully trained service station managers, operating conveniently located outlets served by a fast and efficient distribution system, deliver to motorists at a right price the high quality gasoline needed for pleasant motoring.



MAGIC CARPET *for Millions*

High Quality, Low Cost Gasoline Made Possible by Petroleum Technology, Continuous Research

"FIVE, please" . . . "Put in ten" . . . "Fill it up."

These expressions are used thousands of times an hour. They are the purchase orders of American motorists all over the land. They mean gallons of gasoline.

"Five, please," costs the average motorist about a dollar, of which 70 cents is for the gasoline and 30 cents for the State and Federal taxes. The same five gallons in distilled water would cost 50 cents or more. This illustration may serve to indicate why consumers are satisfied that the price of gasoline is "right." There are few commodities these days that sell as cheaply as gasoline which costs about 2¼ cents per pound, excluding tax, delivered into the tanks of millions of automobiles. The surprisingly low cost of gasoline, in spite of the increase in taxes, is another major benefit of the petroleum industry's efforts to deliver more and better products at a fair price.

The posted price at a service station covers not only the purchase of the gasoline, but a substantial tax payment to the State and Federal governments. Gasoline taxes now provide great revenue not only for the construction and maintenance of highways, but also for a number of other purposes including substantial sums for education. The taxes collected on the sale of gasoline amounted to more than a billion dollars in 1945. Gasoline taxes have increased greatly since they were originated about 25 years ago. In 1920, the average gasoline tax was only a fraction of a cent per gallon. Ten years later, the tax had increased to an average of 4 cents per gallon, and currently it is about 6 cents per gallon. The increase in the tax levied on gasoline has tended to obscure the downward trend in the price of gasoline itself, even though the reduction since 1920 has been large. The actual payment for gasoline is now 14 cents a gallon, compared with more than 25 cents in 1920, whereas the total cost, including taxes, is 20 cents, compared with 25.5 cents in 1920. The downward trend in price is a reflection of the industry's success in meeting constantly increasing demands.

The oil industry has done a remarkably efficient job of delivering all petroleum products to consumers. This is evident from a brief analysis of the work and money required to deliver gasoline to the motorist for 14 cents a gallon. The oil industry has invested billions of dollars and spends hundreds of millions annually to deliver petroleum products to American consumers. The process involves the search for oil; the drilling and development of new fields; the lifting of the oil from a depth of thousands of feet underground to the surface; the transportation of oil by pipe lines, tankers, tank cars, and trucks; the refining of the crude oil into scores of widely different products; and the distribution of those products to thousands of bulk and service stations, farms, and residences.

The search for oil is a complicated business in itself. It involves exploration by the use of modern techniques and the drilling of exploratory wells to determine whether oil exists in sufficient quantities for commercial production. Only about one exploratory well in six is completed as a producer. Of all the wells drilled in the United States annually, more than one-third are dry holes. The cost of drilling wells frequently amounts to $50,000 and more. Some exploratory wells cost over half a million dollars, and may be dry! It is necessary to drill deeper and deeper wells in the search for oil, a trend which means steadily increasing costs for crude oil.

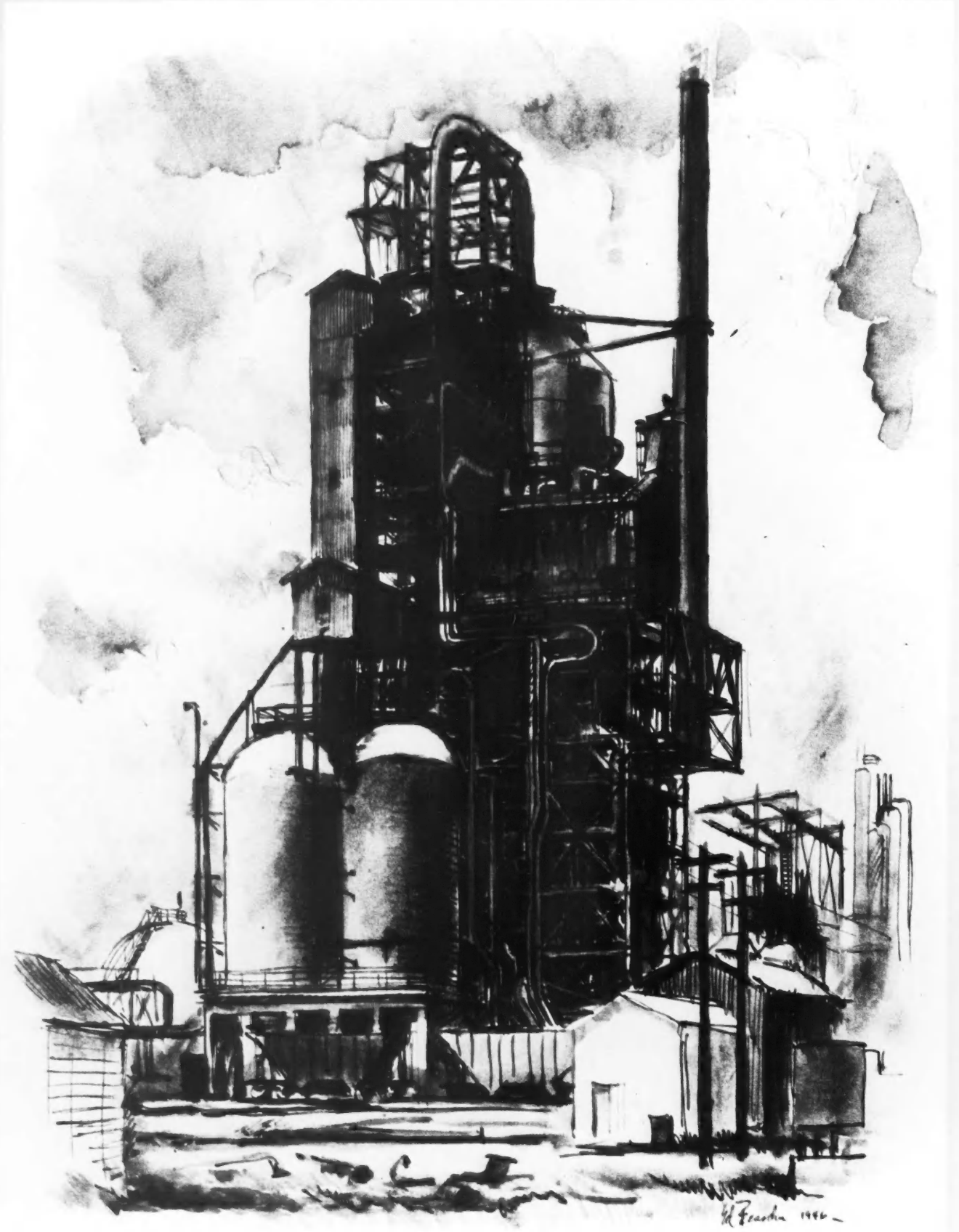
After the crude oil is found, developed by the drilling of wells, and lifted to the surface of the earth, it must be moved hundreds of miles to refineries for processing. The petroleum industry has developed a remarkably efficient and specialized system of transportation by pipe lines and tankers. About 115,000 miles of pipe lines gather oil from 420,000 wells in the United States and carry it to refineries and terminals. Substantial quantities of crude oil and very large amounts of products are moved by tankers, particularly to the East Coast. The transportation by pipe lines and tankers is much cheaper than by tank cars, resulting in lower costs for petroleum products. In recent years, increasing quantities of gasoline are being moved by pipe line from refineries to consuming centers.

The refining of crude oil is a complicated and highly technical operation requiring facilities that involve large capital investment. The modern refinery is a maze of units with pipe, valves, pumps, cooling towers, and other equipment needed to process crude oil into products ranging from gasoline to asphalt, wax, raw materials for synthetic rubber and chemicals, and even to medicinal products.

From the refinery, the products move in a steady flow to the markets of the world. The industry's transportation and distribution system delivers products to every village and community and to thousands of farms throughout the country. Service stations are located conveniently on every highway and in every city, so that the average motorist is seldom far away from a supply of gasoline.

All this work, plus a careful check of tires, oil, and water by the salesman, for 14 cents a gallon of gasoline! It is remarkable that the industry has been able to deliver petroleum products for such a low cost. Not only has the cost been kept low, but the quality and service rendered to the motorist have been improved steadily. Lubricating oils have improved greatly in quality, but the advance that has been of most notice to the average consumer has been in gasoline quality.

(Continued on page 16)



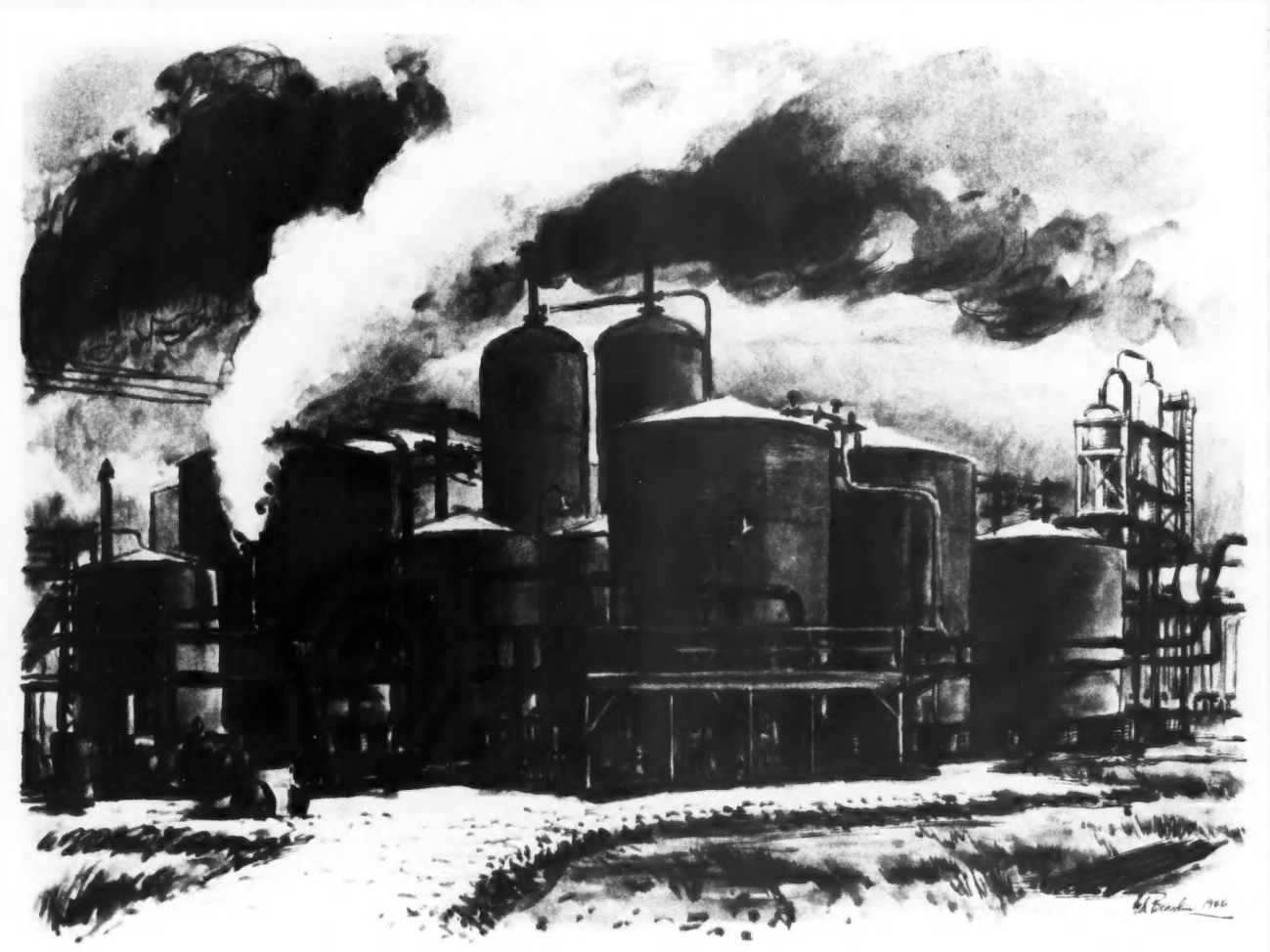
These Make High Quality and Low Price Possible

Quantity production of high quality gasoline at a right price is possible today largely because of refining units like the two depicted on these pages by Artist Ed Bearden of Dallas. At left is one of the two giant fluid catalytic cracking units at the Company's Baytown refinery; below is a section of the alkylation unit at the same plant.

Fluid catalytic cracking is a wartime improvement over the older process of thermal cracking. The catalyst agent used in these units is a finely powdered clay which is mixed with vaporized feed stock. The mixture circulates through the tall unit in the same manner as liquid while the catalyst promotes the cracking action. Baytown's two "cat crackers" charge a special gas-oil selected to give the highest yield of quality gasoline base stock, pentylene and isobutane for alkylate, and other materials that go into quality motor gasoline.

The alkylation unit, first commercial unit of its kind ever built, was completed in 1938. Enlarged to five times its original capacity to help meet wartime demands for 100-octane aviation gasoline, this plant produces alkylate synthetically by combining isobutane with butylene and pentylene, light hydro-carbons derived by cracking crude oil. Finished alkylate is an essential blending agent in the manufacture of aviation gasoline and Esso Extra motor gasoline.

Catalytic cracking and alkylation facilities enabled Baytown refinery to be the first in the nation to manufacture one billion gallons of 100-octane aviation gasoline for war use. Today, those same facilities place Humble in the enviable position of being able to supply the growing demand of Texas motorists for Esso Extra — the highest quality gasoline available on the market.



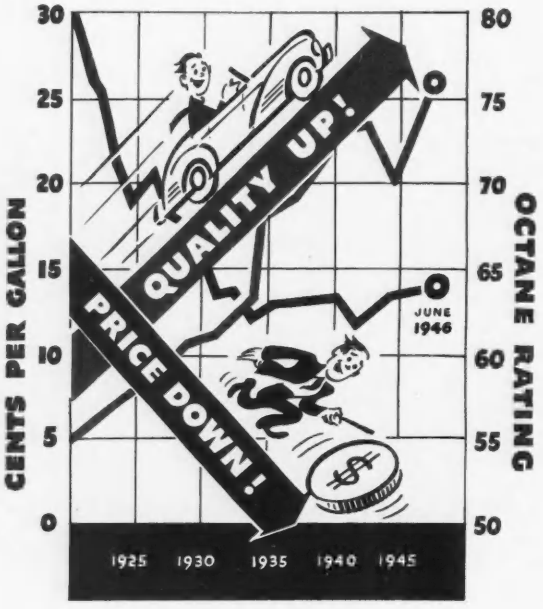
(Continued from page 13)

Refineries, in the competitive effort to acquire a larger share of the gasoline market by giving the consumer a better product, have improved gasoline greatly. A great deal of research and technological development was required to develop the high quality gasolines now being marketed. Twenty-five years ago, the concept of octane rating was not even known. Differences in gasoline were not apparent. The gasoline of that period could not be used in modern cars. The steady improvement of gasoline quality has permitted automobile manufacturers to build more efficient engines which utilize the additional power of the improved fuel. The extent of the improvement is indicated by the 25 per cent advance in octane rating, which measures quality, between the late twenties and 1941.

The equilibrium between gasoline quality and engine design, which had been maintained for more than a quarter of a century, was suddenly disturbed by the war. The break was caused by the wartime demands for high-quality aviation gasoline in tremendous quantities. In order to provide superfuel for the thousands of allied war planes, it was necessary to use the best components for aviation gasoline. This involved some sacrifice in the quality of motor gasoline available to civilians. As a result, the octane rating of regular grade gasoline dropped noticeably. Many motorists became aware of the change by the "knock" that suddenly developed in their automobile engines. They probably did not realize that the gasoline was of a quality not much different from that generally marketed in 1936 and that the "knock" was due to the change that had been made in compression ratios to utilize the improved gasoline, so that 1936 quality was no longer adequate.

During the war, tremendous technical advances were made in the refining of motor fuels under the stimulus of supplying 100 octane aviation gasoline and other products for military use. It is estimated that in the years 1942-46 the industry spent about one billion dollars for new refinery facilities alone, much of which was for cracking equipment. These changes made it possible for the industry to improve gasoline quality materially as soon as the end of the war reduced the heavy demand for aviation gasoline.

Humble's Baytown refinery was one of the leaders in the manufacture of 100 octane aviation gasoline during the war. The facilities constructed during the war placed Humble in a fortunate position to manufacture high-quality gasoline immediately after conclusion of the war. The transition giving effect in civilian products to five years of wartime research and development began as soon as the end of the war occurred. Two weeks after V-J Day, a new and better gasoline, superior to any motor gasoline being marketed in 1941, was made available at all Humble's service stations. The effect was startling. The motorist's prewar car no longer "knocked," but instead, it "purred"; it performed again as it had years before. Once more, the competitive effort of individual companies to improve their marketing worked to the advantage of the consumer.



The great strides made by the oil industry during the past twenty-five years in lowering prices and improving quality have been made possible by the expenditure each year of millions of dollars for new and better facilities. In the past few years, investments in plant and facilities in the oil industry have been almost a billion dollars a year, and the total investment in such properties is now about $18 billion. The return to the industry on its invested capital is only about 7 per cent annually, reflecting the effectiveness of competition in keeping the margin of profit small. It is because of the principle of low prices and large volume that five gallons of high-quality gasoline cost only about one dollar, including thirty cents tax, even though a large investment is required in order to supply the products needed by the average consumer.

The industry's expenditures and investments are increasing steadily each year as the costs of producing and refining oil, its basic raw material, increase. New oil is becoming harder to find and production in older low-cost fields is dwindling. Wells are getting deeper and more expensive. Refinery units become more complicated and expensive as quality standards are raised. As in the past, great effort is being devoted to research and technical development, indicating the industry's awareness of the problems it faces in continuing to meet demands at reasonable prices.

The importance and value of low-cost, high-quality petroleum products to the American way of life is probably evident most clearly in the widespread use of automobiles. Five gallons of gasoline move the average car about 75 miles, providing a great deal of pleasure and satisfaction at a cost that is very low in comparison with other methods of transportation. That is why so many millions of American families depend on their cars for recreation on weekends and vacations. Furthermore, the value of personalized transportation available at all times and ready to take passengers from their home directly to whatever destination they choose is great, even though it cannot be measured in terms of money. The gasoline-powered automobile is literally a "magic carpet" that helps millions to travel conveniently and cheaply, over superb modern highways, whenever and wherever they wish.

SEATED AT MICROSCOPE, MISS ALVA ELLISOR, FIRST HUMBLE MICROPALEONTOLOGIST, PREPARES SLIDE FOR EXAMINATION

The Search for OIL

By F. W. Rolshausen and R. D. Woods

Paleontology uses microscopic organisms in the earth's layers to point the way to oil bearing sands

MEN have acquired much information about the inside of the earth on which they live from careful study down through the years of the various layers of earth, sand, and rock. First observed were those appearing in natural outcroppings at the surface; later, those which have been brought up in the process of wresting the great variety of known minerals from nature's underground storehouse. Moreover, scientific specialists in recent years have gone much further than a mere study of the strata; for the purpose of correlation and age determinations they have isolated and systematically catalogued the thousands of minute organisms within the beds.

Exploration geologists, charged with the responsibility of finding traps favorable for oil accumulation, utilize many techniques, among them structural contour maps. Familiar features such as hills, valleys, ridges, plateaus, and the like are shown on maps by surface contours—imaginary lines of equal elevation above sea level. Similarly, the geologist shows variations in the layers of the earth by means of subsurface contours—imaginary lines of equal elevation from sea level to a common bed or formation. Obviously, the bed or formation must be determined at many localities either on the surface or from a number of different wells before the contour map can be drawn. To do this the beds or formations are matched from well to well or outcrop to outcrop to determine their degree of equivalency, a process known as correlation. The examination of well samples is an important step in this process. Both lithology and fossils are used.

Lithology implies the character of the rock itself—whether it is a limestone, chalk, shale, clay, sandstone, gravel, etc. Some beds, both fossiliferous and non-fossiliferous, have distinctive characteristics which persist over wide areas. Lithology thus is an important aid to correlation.

Fossils, however, remain the principal key to the arrangement of earth layers. Many types can be and have been used in correlation—gastropods, oysters, pelecypods, corals, star fish, sponges, various vertebrates. These large forms are not so suited for well work as drilling usually shatters them beyond critical identification. Something smaller which will

reach the surface in recognizable form is required. There are several possibilities, but in this geologic province the foraminifera are more abundant and geographically widespread than any other small types. Foraminifera are an order of the Protozoa. They are unicellular, usually microscopic, animal organisms which secrete calcareous, arenaceous, or chitinous shells. Many of the fossil forms have restricted vertical ranges making them excellent key or marker fossils; i.e., they are confined to a definite zone or formation; hence finding them in a well sample signifies that the drill bit has penetrated the formation.

Historically these minute organisms are interesting. As early as five centuries B.C. Herodotus, the Greek historian, mentioned some of the larger foraminifera. In the first century A.D., Pliny the Elder, a scholarly Roman, made mention of probably the same forms in some of his writings. It remained, however, for Anton Leeuwenhoek of Holland, creator of the first microscope in 1660, to give impetus to the science of isolating and identifying foraminifera. Aided by this new instrument the Italian physicist, Beccaria, described some small foraminifera from the Pliocene sands near Bologna, Italy, in 1771.

The present technique of identification really had its beginning in 1826. In that year d'Orbigny, a French scientist, published his first paper on foraminifera. His continued interest and papers on the subject initiated what might be termed the modern approach to their determination, thus eventually making them a very useful tool for the oil industry.

Since d'Orbigny's first paper, more than 1,000 authors have published 1,500 generic names and approximately 18,000 specific names. The cataloguing of this material by Ellis and Messina in 1940 required 30 volumes of approximately 1,000 pages each. Some 500 pages are being added to this catalogue annually.

Although study has been extensive and writings voluminous on the subject, it was not until about 1920 that geologists were able to make effective application of paleontology to the search for oil. Dr. Udden at the Texas Bureau of Economic Geology as early as 1914 encouraged the use of fossils in well work, but commercial micro-paleontology did not really get under way until initiated here in the Gulf Coast by Ellisor, Knicker, and Richards in 1920.

GUIDE FOSSILS used by micropaleontologists: 1. Frondicularia species, distorted form; 2. Heterostegina compared to texana, guide fossil in Texas and southern Louisiana; 3. Marginulina compared to vaginata, from a well in Brazoria County below 10,000 feet, guide fossil in Texas and southern Louisiana; 4. Textularia warreni, guide fossil for Upper Vicksburg in Texas; 5. Hantkenia compared to alabamensis, guide fossil for the Eocene; 6. Massilina Pratti, named in honor of Wallace Pratt, former Humble vice president; 7. Textularia hockleyensis, guide fossil for McElroy formation; 8. Textulariadibollensis, guide fossil for Caddell formation; 9. Textularia smithvillensis, guide fossil for Weches formation; 10. Lamarckina claibornensis, guide fossil for Weches formation; 11. Vaginulina webbervillensis occurs in the Upper Cretaceous just above Nacatosh sand formation; 12. Planulina taylorensis, guide fossil for Upper Taylor formation; and 13. Frondicularia compared to sagitulla (recent from the Gulf of Mexico).

About that time they began a microscopic study of well samples with the object of making more accurate correlations and age determinations. Many criteria were explored: the lithology or type of rock-sand, shale, limestone, etc.; analyses of sands—their grain size, shape, and composition; the fossils, and other characteristics. These early efforts were not too successful, although several appeared promising. Continued study by a great many geologists and by the specialized group known as paleontologists has developed well sample analysis until now it is an essential part of the complex search for oil.

Shortly after paleontology entered the field of oil exploration the Humble Company's laboratory was established. In 1920 Miss Alva C. Ellisor, micropaleontologist, assisted by one sample washer, set up the beginning of the present laboratory. At first it was hoped that the small clam and snail shells found in some of the samples could be used for correlation purposes. However, Miss Ellisor found some foraminifera in a core from a Humble well at Goose Creek and since that time foraminifera have been found to be widely distributed; in fact, nearly every well will have a few somewhere in the sections penetrated. Some of these are very

(Continued on page 20)

ALL SAMPLES are checked and systematically recorded upon arrival.

PORTION OF EACH sample is placed in numbered dish for soaking.

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useful for correlation purposes and for determining the age of the material the drill has encountered.

So greatly has the work of the Humble laboratory expanded since 1920 that today there are 12 micropaleontologists, two research paleontologists, and some 20 sample washers and sample record clerks. Every month thousands of samples pass through the laboratory and under the watchful eyes of the micropaleontologist. It is estimated that when all the microforms occurring in the samples have been compiled and catalogued they will number somewhere between 10,000 and 12,000.

The process by which materials are routed into the laboratory for study is interesting. Whenever a well is drilled, either cores, cuttings, or bit samples are taken. Core samples are obtained by lowering a special tool to the bottom of the hole, cutting a portion of the formation, and bringing the tool and the material to the surface. During normal drilling, while the bit is being rotated at the bottom, mud is pumped through the holes in the bit. This mud returns to the surface and brings with it fragments of the formations being drilled. These fragments are caught, sacked and labeled, and brought in to the laboratory. When the drill pipe and bit are brought up out of the well, some mud usually sticks to the bit. This bit sample is also collected and sent in.

In addition to well samples, a few from surface outcrops are received from time to time. Some of these are highly fossiliferous; in others no shells are found, either because of weathering or because living conditions at the time of the deposition of the formation were unfavorable for animal life.

This great variety of samples flows in constantly to the laboratory—in sample bags, jars, wrapped in newspaper, and in various other forms. During 1945, approximately 220,000 samples were received, an average of 80-85 per cent from outside wells and 15-20 per cent from Humble wells.

The following table shows the number of samples handled annually for the past 15 years:

1930	1931	1932	1933	1934	1935
71,400	66,500	73,500	90,200	185,000	225,827
1936	**1937**	**1938**	**1939**	**1940**	**1941**
249,000	369,500	310,600	270,400	260,200	190,000
1942	**1943**	**1944**	**1945**		
170,000	150,000	193,000	220,000		

Immediately upon receipt of samples in the laboratory a record is made showing the name of the well, the driller, the county in which the well is located, the interval covered by the samples, and the number of samples. If the samples are not to be worked immediately, they are filed for future reference. If they are to be worked, the samples are lined up according to depth, are recorded, and a small portion of the material is placed in a numbered dish. The sack containing the remaining original material is placed in a bin having the same number as the dish. A small paper envelope, labeled exactly like the original, is also placed in this bin. The dishes are then set in trays and the trays stacked in a large cart; water is added to the samples to soften them.

After soaking, the samples are washed in a sieve under a stream of water. Clay and silt wash through, the process being aided by rubbing fragments against the side of the sieve if necessary. When all samples in a cart have been washed, the cart is placed in a large oven and the samples are thoroughly dried by heating for about one hour at approximately 400 degrees Fahrenheit.

When cooled, the residues in the dishes are placed in envelopes which along with the sacks containing the original material, are sent to the microscope room for examination. The inspection under the microscope is a careful one, and complete information is recorded. The texture, type, and color of the original material is described and recorded; the minerals and fossils noted in the residue are also recorded. Not every sample is thus meticulously examined, but enough samples are studied and described to insure accurate determination of the type of material the drill has penetrated.

Experienced eyes behind the microscope, long accustomed to looking at residue samples, can readily detect small differences in lithology and fossil content and can use these differences as markers. Too, after finding these markers in certain areas, examiners know that other markers will appear below in a definite order. The interval between these markers is very important as either thinning or thickening when compared to other wells in the area indicates structures, and structures may yield oil.

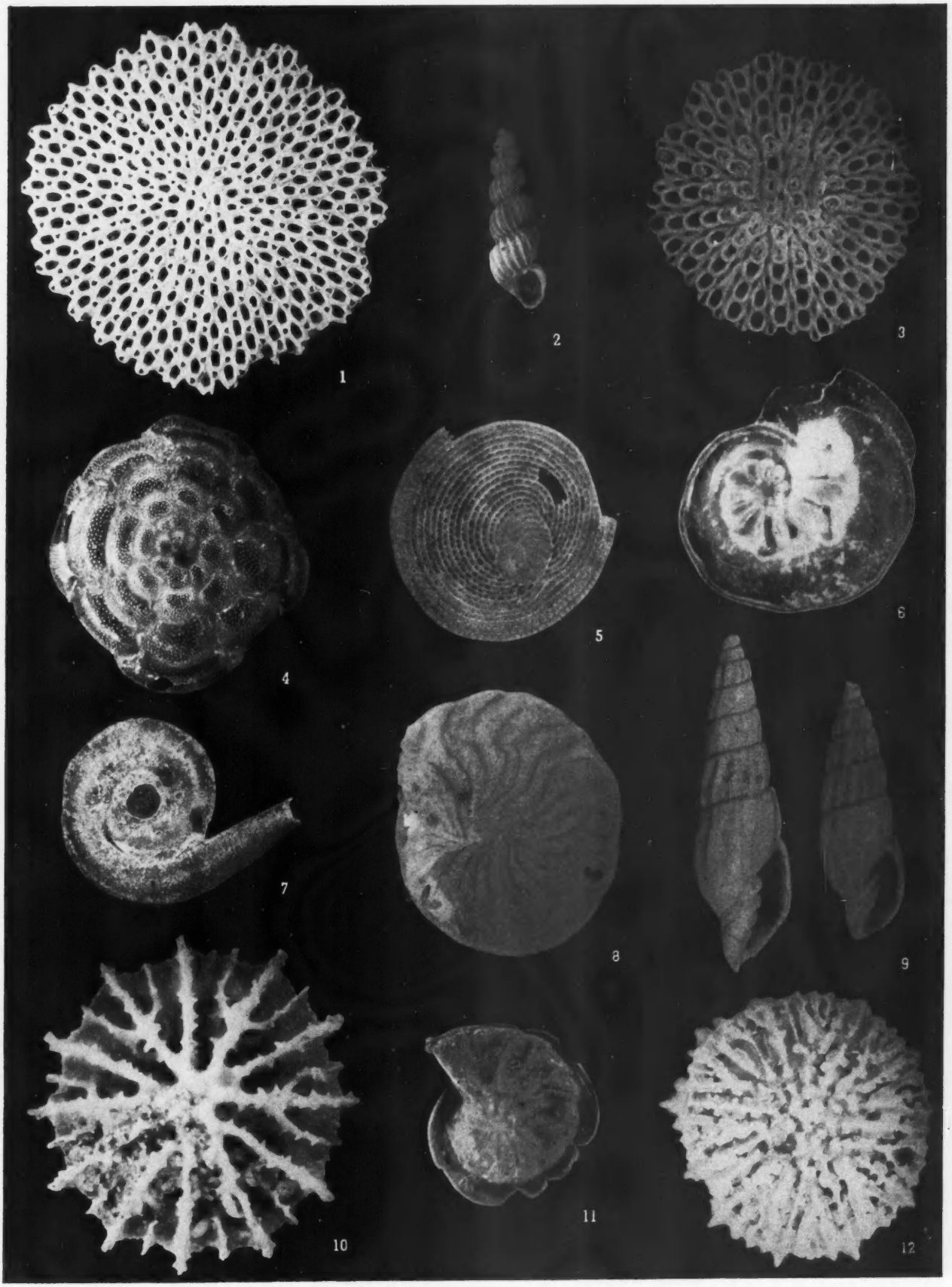
In addition to the examination for lithology and fossils, samples may be studied for their oil content. Heavy mineral analyses are occasionally made; petrographic reports are written on metamorphic and igneous rocks; polished sections are made of limestones; the residues and faunas of key wells are slided and kept in a permanent file. Determination of the presence and reliability of markers as new areas are opened by drilling is a continuing problem. Unfortunately key "bugs," as they are called by paleontologists, have some "human characteristics"; they sometimes tend to wander from their proper positions and it is a more or less constant problem to check up on them.

When the paleontologist has finished his examination, he files the original samples in one container and the residue in another. Both are sent to a warehouse for storage and future use, even though they have already given up much valuable information.

What happens to the information which the microscope has revealed and which the paleontologist has very carefully recorded? The report is typed and distribution is made to the chief geologist for general information as to sections drilled; to the division geologist in the area from whence the sample came, who uses the report in the preparation of contour maps and cross sections, and in general to help him with subsurface problems; to the chief scout for his records; to the operator, if requested; and to the geologic laboratory files for records and comparison with future wells in the same area.

Twenty years ago the 3,000-foot well was considered a deep well. Today, the 13,000-foot well is fairly common. One well has been drilled below 16,000 feet; several have been drilled beyond the 15,000-foot depth. This trend toward deeper drilling means that new strata are being penetrated—strata having new faunas due to different environments. The interpretation of these faunas will require the best talents of micropaleontologists for years to come. Theirs is the opportunity to explore these new depths and to contribute materially toward the greater knowledge necessary to find oil at these deeper horizons.

DIFFERENT FORMS which may be seen while examining washed residues: 1 and 3, Bryzoa. 1. Recent foraminifera; 2. Caliborne foraminifera; 4. Planulina compared to mediterranensis (recent); 5. Sorites compared to marginalis (recent); 6. Laticarinina compared to marginalis (recent); 7. Tubulostium species, Claiborne; 8. Operculinoides species; 9. Gastropods, Claiborne foraminifera; 10 and 12. Corals; 10. Recent foraminifera; 12. Claiborne foraminifera; and 11. Lenticulina.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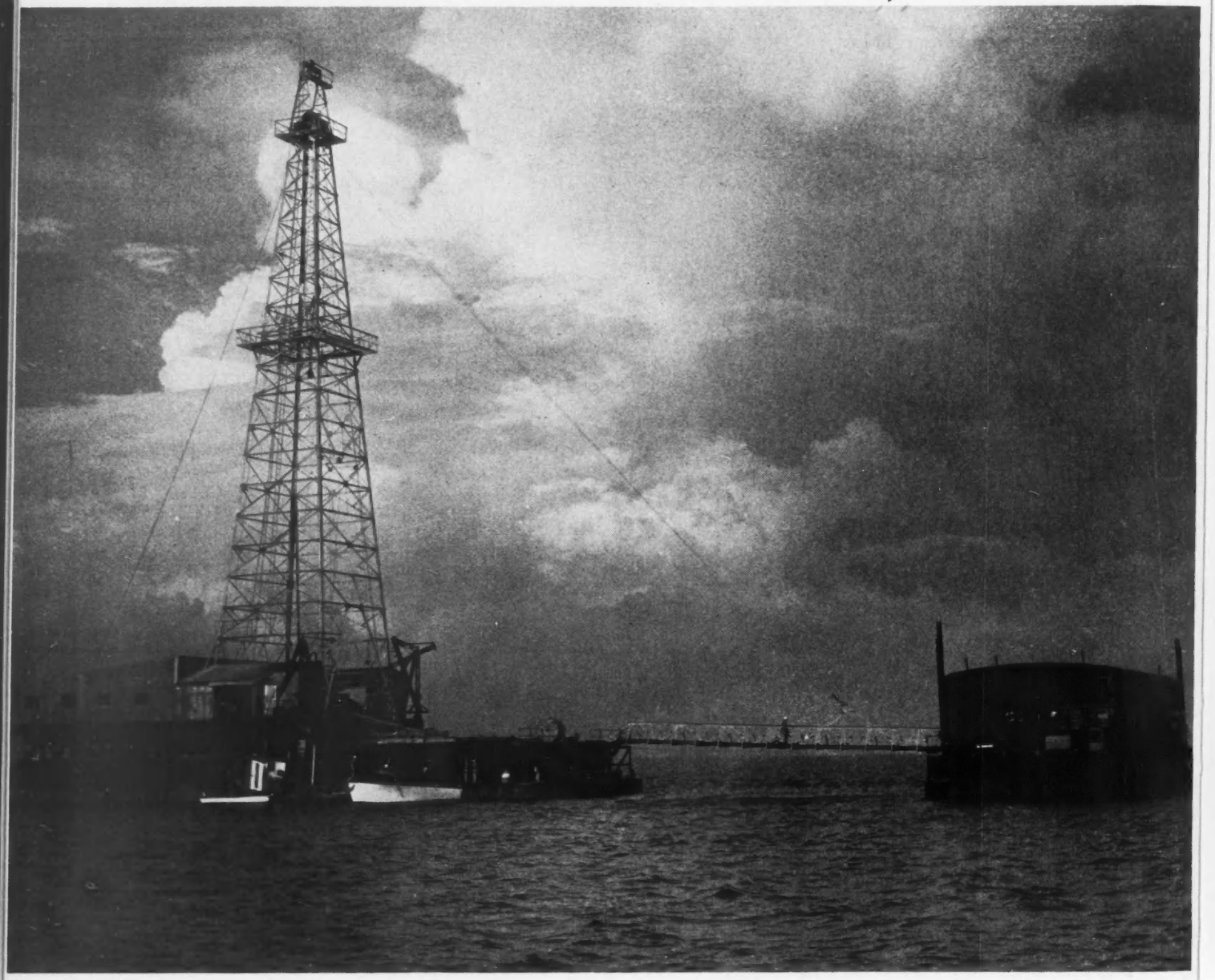
Super BARGE RIG

TO EXPAND its operations in coastal areas with the greatest possible flexibility and freedom of movement, Humble has come up with more superb equipment for its Production department. This time it is a new Diesel electric barge drilling rig which deserves, by even the most conservative standards, the prefix "super."

Catalogued by the rather undramatic designation of Drilling Rig No. 195, this largest and most powerful of all Humble barge rigs will be used for under-water drilling in lakes, bayous, and coastal shallows. Several months a-building, it was completed early in September at Barbour's Cut on the Houston Ship Channel. Soon after it had been declared seaworthy, it was taken out to Red Fish Reef in Galveston Bay, where a test was run to 3000 feet and surface casing set. Following the test, the rig was returned to the Cut for minor changes and additions. On September 27, it began its maiden voyage through the intracoastal canal, bound for Bayou Sale in Louisiana.

STURDIER, MORE POWERFUL THAN OTHER HUMBLE BARGE RIGS, THE NEW SUPER UNIT DIFFERS LITTLE IN APPEARANCE



The new rig is designed for normal drilling operations up to 15,000 feet and can go deeper if conditions require. It has more power behind the drawworks than any other Company barge rig; its drawworks motor is rated at 1000 horsepower and can be overloaded to 1500 horsepower. Built to operate in about 10 feet of water, No. 195 is particularly well adapted to wildcat drilling on locations where fuel and water would be difficult to obtain for other types.

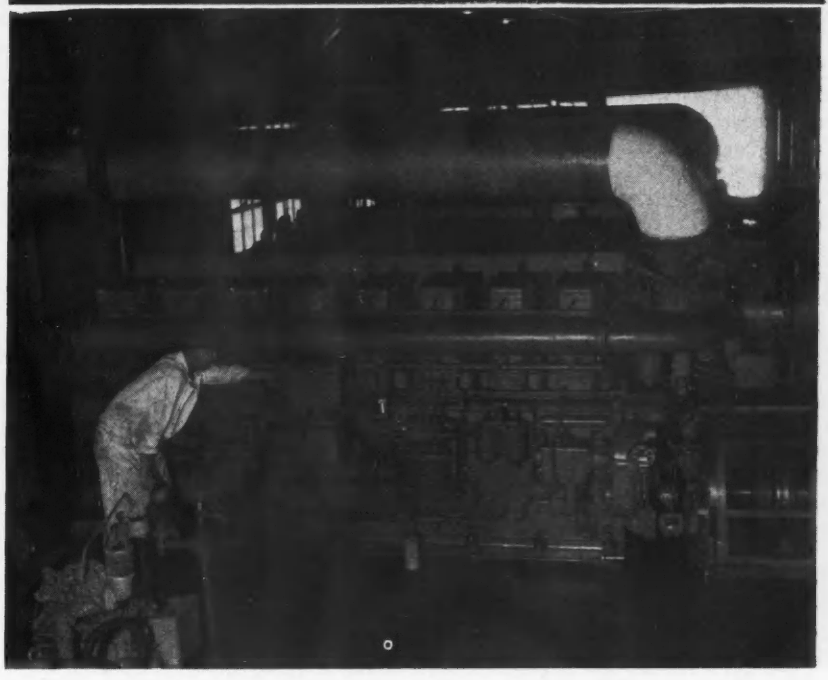
The barge on which the derrick stands is really two barges in one; the twin-hull type. Its derrick straddles a 6-foot opening between the two sections, each of which is 140′ x 24′, or 20 feet longer than any other Company barge rig. This added length allows for handling of 40-foot casing and accommodates the larger power-driven pumps. The two barge sections are joined together by a 14-foot superstructure, and when narrow locks are encountered in Louisiana canals the sections may be divided and floated through separately.

The power barge accompanying the drilling barge and attached to it by a walkway has three 700-horsepower supercharged Diesel engines. Each engine has its own generator and a Thyrite control exciter which maintains constant voltage even though engine speed varies from 450 to 900 revolutions per minute. depending on the job being done.

A new feature, and one used for the first time on Rig 195, is Amplidyne control of the three main generators, which are connected to motors by the Ward-Leonard control system. Amplidyne control, providing current for governors, automatically varies motor speed with the load demand for each particular job.

Comfort and convenience for the crew have not been neglected. Housed on the drilling barge are: an office for the toolpusher, a tile-floored bathroom with shower, a bunkroom, a mud laboratory, and a mud storage room. All except the bathroom are oak-floored.

Oil, according to an old adage in the industry, is where you find it. When you find it under lakes, bayous, or shallow offshore waters, Rig No. 195 and its crew can be depended upon to bring it to the surface.



CREW MEMBER CHECKS blue prints (above) to gain better knowledge of the big electric control panel behind the draw works. At right, operator makes routine check on one of three 700-horsepower supercharged Diesel engines which furnish power for the drilling rig.

METALLURGISTS MEASURE RESIDUAL STRESS OF CASING BY EXTENT TO WHICH SAMPLE RINGS SPRING APART WHEN CUT

FAULT FINDING LAB

DURING the Middle Ages, it was almost a point of pride among certain monarchs to equip royal dungeons with the very latest in torture devices. In the hands of an experienced gaoler, these medieval lie detectors wrung quick and complete confessions from their victims in the shortest possible time. It was a hardy heretic who could take a breaking on the wheel or a stretching on the rack without parting from a secret or two.

Those masters of mayhem might have paid a king's ransom for any one of a dozen or so instruments used by today's metallurgists in determining the cause of equipment failure. To get the truth out of faulty casing or other metal equipment which failed in the field, metallurgists in Humble's Service Laboratory make use of devices which twist, break, and pull apart pieces of the strongest steel.

From the moment they leave the jobsite for the Laboratory's Metallurgy Section, samples of faulty equipment are doomed for what might be called constructive destruction. As they are bent, broken, and boiled in acid, metal samples have no choice but to give up their secrets.

Let us say, for example, that a section of split casing is sent in after being recovered from a Humble well. First, the entire sample is photographed for the record. Then a close-up is taken of the failure section. Now the pipe is ready for the machine shop, where rings are cut off for residual stress tests. A cut or slice is made at one point through the ring, and residual stress is calculated from the extent to which the ring springs open at the cut.

In some cases, hardness of the steel is an important property. A small metal ball, weighted and pressed into the surface of the sample, determines hardness by penetration. This is called the Brinell hardness test.

Are there irregularities in crystalline structure and heat treatment? To discover them, the metallurgist cuts off one or more small pieces, polishes them to mirror brightness, etches the surfaces in an acid-alcohol solution, and studies them under a powerful microscope. Photomicrographs, or pictures taken through a microscope, are made.

Next, tensile strength is determined. A strip shaped much like a double-bladed oar is cut out. The two ends are placed in a testing machine and a giant tug-o-war begins. The pull point at which the "handle" of the oar snaps reveals the metal's tensile strength.

Strain lines in the metal give important information, too. They are brought out by macro-etching; that is, placing the metal in hot, dilute hydrochloric acid. This hot acid bath brings out definite, visible lines of strain and may also reveal certain defects, such as porous metal, cracks, and inclusion of impurities.

What is the steel made of? Does it have too much or too

little of some important hardening or toughening agent? Is the elemental composition of the metal uniform throughout, so that no weak spots have been set up? Shavings are cut from the sample and dissolved in acid. Then chemical analyses are made to determine the presence and quantity of such elements as carbon, phosphorus, manganese, silicon, sulphur, and special alloying elements. Quite often, scales found on specimens must be analyzed, too.

When all tests are complete, results are transmitted to the member of the Petroleum Engineering Division who is most concerned with the design and use of that piece or type of equipment. With accumulated data, the engineer may proceed toward a logical solution of the problem. In the case of faulty equipment, some corrective measures are usually necessary. Discussions may be held between Humble and the manufacturer, out of which will come suggestions for changes in equipment design, manufacture, or mode of operation.

Aiding in post-mortem examinations of faulty equipment is not the only duty of the Service Lab's Metallurgy Section. Some work is done here to foresee and prevent premature failures of such equipment as wire rope. Fitness of the rope is determined by use of a machine which twists individual strands of wire until they snap in two. This is called torsion testing. There is also tensile testing, which consists of pulling wire strands at both ends until they snap in the middle. If Company standards are not met, the wire is condemned.

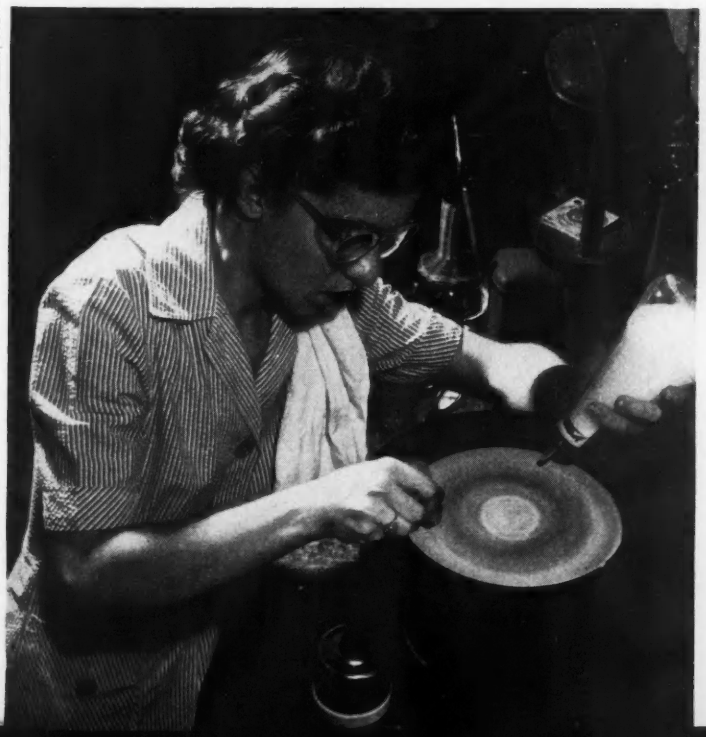
In conjunction with examinations of field equipment which has failed due to corrosion, the Metallurgy Section conducts experiments with plastic and metallic coatings designed to prevent or at least control corrosion. Small strips of coated steel are immersed in corrosive liquids including salt water, acids, bases, and crude oils to which operating equipment is exposed. After immersion periods at room and elevated temperatures, the strips are removed and inspected for corrosion.

The work of the Metallurgy Section, then, is destruction with a purpose. Facts from each test are assembled to answer, or help answer, the single question: "Why did it fail?" In doing so, the laboratory places in the hands of engineers the basic facts for answering still another question: "How can it be made better?"

It is a service which makes for more efficient, more economical operations.

BRINELL HARDNESS TEST consists of forcing a hard steel ball into the metal's surface, then measuring penetration at definite pressures.

ALUMINA SOLUTION, dripped on a revolving felt buffer, adds final polish to surface of metal samples being prepared for photomicrographs.



STRAIN LINES are revealed when split sections of metal are macro-etched in hot acid. Cuttings for chemical analyses leave rows of holes.

PEG MAP

Humble geologist builds scale map as aid in visualizing salt dome provinces in Gulf Coast area

SALT from the ancient beds of prehistoric inland seas has pushed its way up for millions of years through overlying rock in a relentless climb, resulting in plugs or domes which today are the petroleum geologist's key guide on the Gulf Coast.

That is the way nature has performed her fascinating underground drama—a drama which Humble geologist P. H. O'Bannon has simplified and made more universally comprehensible. His salt domes are made from soft pine with pocket knife, saw, sand paper, and paint brush—in his spare time. And he began the manufacture of salt domes only 15 years ago when, as a production geologist in the Gulf Coast division, he saw the need for an aid in visualizing the relative size and territorial distribution of salt dome provinces in the Gulf Coast region.

He conceived the idea of a scale peg map to include the shape and size of all known salt masses. The map was executed from interpretations of all available drilling and geophysics information, and was designed to give the geologist and layman something of an X-ray view of the earth's first 20,000 subsurface feet. It is 10 feet long, four feet wide, and is mounted two inches under glass, with pegs representing the shape and size of all known salt masses on the Texas and Louisiana Gulf Coast.

Vertical scale of the map is one inch for every 10,000 feet in depth; horizontal scale is one inch for every four miles. Boundary outlines are marked on the base map as well as on the glass covering, giving the illusion that the first 20,000 feet of the earth has been simply stripped away to leave the naked salt domes.

In carving the miniature salt domes,

GEOLOGIST O'BANNON CHECKS WELL LOG TO GATHER ACCURATE INFORMATION BEFORE MAKING MINIATURE SALT DOMES

DRODDY AND KAEPPEL STUDY ORIGINAL O'BANNON CREATION BEFORE BEGINNING WORK ON A MORE EXTENSIVE PEG MAP.

geologist O'Bannon has interpreted drilling and geophysics information with extreme care. The salt masses are accurate reproductions in every detail and are placed on the map just as nature has placed them in the earth. Bullet shaped domes, slender spines, overhangs—all the peculiar characteristics of salt plugs—he has translated into his minute pegs.

After experimenting with plastics and numerous types of wood, creator O'Bannon found that soft sugar pine was the ideal material from which to carve the map pegs. He even called on an artist friend to mix a dull gray shade of paint to match the exact color of actual salt samples from the earth. All pegs are painted in this color and the tops are painted black to represent the thickness of the cap rock, or yellow to indicate that they are producing or have produced sulphur. The pegs are cemented to the map and remain in position whether the map is drawn up against the wall or is standing on its portable legs to form a table.

The first map was completed by geologist O'Bannon in 1930 and proved popular, not only for reference work but also for exhibition. It was used in meetings and in special displays, and several years ago when it was damaged beyond repair while being transported, he immediately began work on a new map which was completed some months ago.

A similar but more comprehensive map, fashioned after O'Bannon's original creation, was recently completed by L. J. Droddy, Al Kaeppel, and Earl Chase of the scouting section of the Exploration department. The new map covers more territory, including all known piercements of salt domes in the Gulf Coastal area of the United States. In addition to salt deposits, surface geological formations are indicated by different colors.

The recent map, like its predecessors, employs pocket knife, saw, and sand paper salt domes to help tell the story—old to many but ever fascinating—of where oil has been found or may yet be discovered.

By the way . .

Group Insurance Date Change

The effective date for increasing Group Life Insurance has been changed from October 15 to December 15 of each year, according to a recent announcement from the Annuity & Benefits department. The salary of the employee on October 1 will be used for arriving at the amount of insurance employees are able to carry. Since October 1 salaries are also used in determining the annuity class of employees under the Annuity & Thrift Plan, the change in the insurance date effects a considerable saving in time because it makes possible the handling of both plans with a single review of payroll records.

Appointed on Award Committee

President H. C. WIESS, winner of the Mid-Continent Oil & Gas Association "distinguished service" plaque in 1944, was recently appointed to serve on the American Petroleum Institute's new committee on "Award for Distinguished Achievement."

Newspaper Writers Visit Texas

Twenty-six prominent Eastern newspaper writers were guests of the Humble Company for a week-long tour of oil operations in Texas and Louisiana early in October. The group was brought to Houston under the auspices of Standard Oil Company (NJ). After hearing a series of lectures on various phases of oil operations in Houston on Monday morning, September 30, they were taken to Kingsville to visit the Stratton and Seeligson oil fields and to enjoy a barbecue given by King Ranch. The next visit was to the Hawkins and London districts in the East Texas area. Back in Houston the group toured in order the Katy Cycling Plant, Schlumberger and Hughes Tool Company plants, Humble Pipe Line Company station at Webster, and Humble's Galveston Bay operations. From Galveston the writers went to New Iberia, Louisiana, for an inspection of the Avery Island field, and thence to New Orleans.

Retirements

CARL B. STOLZ, 61, Building maintenance employee, Houston Office, retired on July 22 . . . WESLEY M. VIRDELL, 63, pumper at Odessa, Production department, on August 27 . . . JOHN N. BRINKLEY, 60, press operator at Baytown refinery, on September 24 . . . GEORGE P. FOSTER, 60, janitor at Baytown refinery laboratory, on September 28 . . . WILMER E. BURCH, SR., 59, stillman at Baytown refinery, on September 1 . . . THOMAS J. LAWSON, 61, Production accounting, Houston Office, on September 3 . . . JAKE HODGES, 65, laborer at Baytown refinery, on September 4 . . . MRS. AGNES S. RAMSEY, 55, Building maintenance, Houston Office, on September 11 . . . and LAWRENCE E. LEWIS, engineer in the Cisco district, HPL, on September 19.

Deaths

HENRY C. WRIGHT, 49, loan equipment clerk in the Sales department, Houston, died on July 21 . . . WILLIAM H. WARD, 56, telegraph operator at Satsuma Station, HPL, on August 15 . . . UPTON MCGEE HAMMETT, 39, geophysics department at Odessa, on August 31 . . . ABNER SMITH, 62, watchman in Production department at London, on September 2 . . . WILLIAM H. BUSS, 43, assistant district gauger at Luling, HPL, on September 2 . . . John A. Parish, 58, Production department pumper-gauger at London, on September 6 . . . and DONALD F. GILLIES, 37, seismic computer in the Geophysics department, Houston, on September 30.

Annuitants who have died since last publication date are: CHARLES S. THOMAS, 67, engineer at Navasota Station, HPL, until his retirement on February 21, 1944, died on August 21 . . . MRS. CLARA R. BRAY, 57, typist in Production accounting, Houston, until her retirement on May 15, 1944, died on September 6 . . . and PATRICK H. SIMS, 66, Production department pumper-gauger at Hardin until his retirement on March 16, 1945, died on September 19.

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Front and back covers: Artist E. M. Schiwetz.

Artist Ed Bearden, who painted the refinery units on Pages 14 and 15, studied at the Colorado Springs Fine Arts Center after graduating from Southern Methodist University in Dallas. For the past four years he has been assistant director of the Dallas Museum of Fine Arts; has won prizes in major shows in the Southwest; is instructor in art at S.M.U.

WASHED AND DRIED well samples are placed in small numbered envelopes, are attached to original sample bags, and both are sent to the paleontology laboratory's microscope section for examination. *(The Search for Oil, Page 17).*

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